agriculture

Vol. 76 No. 8 August 1969

Published for the Ministry of Agriculture, Fisheries and Food
by Her Majesty's Stationery Office

1s. 3d.
MONTHLY

A SERVICE IN GOVERNMENT PUBLICATIONS

Her Majesty's Stationery Office offers its readers a comprehensive service that will enable them to judge which titles in the vast output of Government Publications would help them in their work or leisure.

Catalogues are published daily, monthly and annually; in the latter two cases, Statutory Instruments are omitted, and separate catalogues for these are published. In addition, numerous sectional catalogues, issued free of charge, list the publications sponsored by individual Government Departments, and in some cases lists covering special subjects are available.

You can obtain full information about this service by sending a postcard to Her Majesty's Stationery Office, P6A, Atlantic House, Holborn Viaduct, London EC1, asking for our CATALOGUE SERVICE LEAFLET.

Ask at the same time for the name and address of your nearest official agent for Government Publications.

HMSO

Land Reform in Principle and Practice

DOREEN WARRINER

This book introduces the subject of land reform by distinguishing and systematizing the controversial questions that arise from it, with brief surveys of Iraq, Persia, India, Brazil, Chile, and Venezuela. 8 plates 63/- net.

Using Field Machinery

W. H. BOSHOFF

An introductory text for users or potential users of field machinery in tropical agriculture. There are chapters on tillage machinery, rowcrop planters, dusters and sprayers, grass cutters and harvesters, and ox cultivation. 46 line illustrations paper covers 10/6 net *Oxford Tropical Handbooks*

The Rice Industry of Burma

CHENG SIOK-HWA

An authoritative survey of the development of Burma's rice industry, fully annotated and supported by statistical data. £6 13*s.* net *University of Malaya Press*

Long-Term Projections of Supply and Demand for Selected Agricultural Produce in Pakistan 1961-1975

S. A. ABBAS

This study was prepared by the Social Sciences Research Centre, University of the Panjab, Lahore, in co-operation with the Central Statistical Office, Government of Pakistan, Karachi, the Pakistan Economic Research Corporation, Karachi, and the Bureau of Economic Research, Dacca University. 15 graphs paper covers 30/- net

OXFORD UNIVERSITY PRESS

Midland Managers are down-to-earth

-particularly where farming is concerned

We expect our managers in agricultural areas to have more than a desk-bound acquaintance with the kind of farming that is carried on locally. We like them to know at first hand about the practical problems of a farmer's life. This means that when you have a problem involving money, your local Midland manager is best placed to help you find a down-to-earth practical solution, either from his own knowledge and experience, or with the immediate assistance of senior Head Office officials who are specialists in agricultural finance. He will be pleased to see you at any time. You'll find your local Midland branch's address in the 'phone book.

Midland Bank

HEAD OFFICE, POULTRY, LONDON, E.C.2

Please mention AGRICULTURE *when corresponding with Advertisers*

Agriculture

VOLUME 76 . NUMBER 8 . AUGUST 1969

Editorial Offices
Ministry of Agriculture, Fisheries and Food
Whitehall Place, London, S.W.1.

Contents

© *Crown copyright 1969*

Provided that the source is acknowledged in each instance such articles and notes as are published in this Journal without any specific reservation regarding copyright may be produced in any registered newspaper or public periodical without special permission. The Ministry does not accept responsibility for statements made, or views expressed, in signed contributions to this Journal or in those reproduced from another source.

Further, the Ministry does not accept responsibility for any of the private and trade advertisements included in this publication.

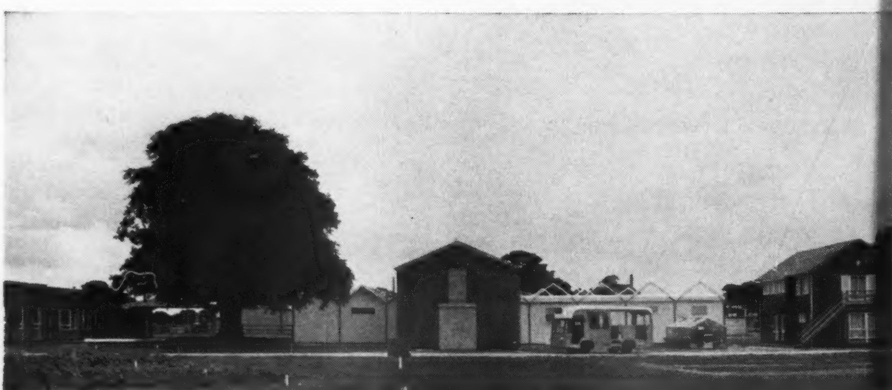
In the interests of factual reporting, occasiona reference in this Journal to trade names and proprietary products may be inevitable. No endorsement of named products is intended, nor is any criticism implied of similar products which are not mentioned.

All communications respecting advertising in the Journal should be addressed to the Advertisement Contractors, Cowlishaw and Lawrence (Advertising) Ltd., 2-4 Ludgate Circus Buildings, London E.C.4. Telephone: 01-248 3718.

The Electro-Agricultural Centre for all advisers

This Centre is a permanent part of the National Agricultural Centre at Stoneleigh. It affords a display of fundamental techniques in the use of electricity in agriculture, as well as providing conference and training facilities. In addition, there is a technical and product information library, and adequate provision for demonstrating new equipment.
This Centre has been established by the Electricity Council to help all concerned keep up to date with the latest electrical developments in agriculture. It operates in conjunction with the Demonstration Areas of the N.A.C. where electrical methods are widely demonstrated as part of the many new farming techniques.
Advice and information about electric farming methods is freely available from the full-time specialist staff in attendance. Facilities for training courses and conferences are available for use by recognised agricultural organisations. The Centre is designed to meet the needs of all sections of the agricultural industry and to assist farmers in their efforts to increase productivity and cut costs.

For further information contact your County or Regional Office, or Mr.R.G. Scott at the Centre.



The Electro-Agricultural Centre, Kenilworth, Warwickshire, CV8 2LS. Tel: Coventry 27338 or Telex: 31543

Issued by the Electricity Council, England & Wales

The basic aim of the Bacon Market Sharing Understanding is to provide for the orderly marketing of bacon in the U.K. and to preserve stable prices at levels reasonable to both producers and consumers

The Bacon Curing Industry in Britain

R. C. Rickard

OVER the past forty years, the quantity of bacon and ham consumed per person in this country has remained almost unchanged at about 25 pounds. Of this amount, roughly 16 lb is imported, principally from Denmark, nearly 3 lb is supplied by Northern Ireland, thus leaving just over 6 lb which comes from the British bacon factories. Britain is virtually the only market for bacon and the export of bacon plays an important part in the economies of a number of countries, particularly Denmark.

Before 1925, trade in bacon was unrestricted but since then the bacon industry has enjoyed some protection in one form or another. For instance, import controls were in operation and tariffs were employed as the main instrument. They were progressively removed and in 1964 the Bacon Market Sharing Understanding was concluded among the principal supplying countries to the British market.

The basic aim of the Understanding, which was renewed on 1st April, 1969, for a period of three years, is to provide for the orderly marketing of bacon in the United Kingdom and to preserve stable prices at levels reasonable

to both producers and consumers. Under the terms of the Understanding, the United Kingdom Government, in consultation with the Bacon Market Council, determines the total quantity of bacon required on the British market as well as the expected level of production from home producers. The difference between these two amounts is divided among the importing countries, with Denmark taking the predominant share.

In April, 1969, a new Order—The Bacon Curing Industry Stabilisation Scheme 1969—was made, which put arrangements already in operation since April, 1967, on a statutory basis. Under the Scheme Exchequer payments are made to United Kingdom bacon curers when their returns from the market are exceeded by the price paid for pigmeat for bacon plus a nominal figure for curing and other costs. A levy is to be paid by the curers to the Exchequer when the trading circumstances are more favourable. The Scheme also provides, amongst other things, for the registration of bacon curers and the keeping of appropriate records.

Pig procurement

The essential raw material of the bacon industry is obviously the pig and the factories in Britain procure their supplies in a variety of ways. Some individual factories buy carcases to augment their own slaughterings but, for the most part, factories rely on live pigs purchased in a variety of ways. These include grade and deadweight arrangements, direct purchase from producers deadweight on a flat rate basis of payment, and purchase through the livestock auction markets as well as from dealers.

Approximately 80 per cent of all pigs marketed in Britain are purchased deadweight, either by wholesalers, butchers or by the bacon factories. Bacon factories take roughly half of these, or 40 per cent of all pigs marketed, and just over half of bacon factory pigs are procured on a grade and deadweight basis. It is estimated that most of the grade and deadweight pigs are bought under contract, mainly through an intermediary agency on a nationally operated pig contract. Some of the bigger factories may operate private contracts on a regional or national basis and many of them stipulate the type of pig required for the particular methods of production carried out by such factories.

Methods of bacon production

During the war years and until 1954, the British bacon industry concentrated on the Wiltshire cure and, furthermore, virtually all bacon at present imported from abroad and from Northern Ireland is in the form of Wiltshire sides. Since then, other methods of curing have increased in importance in Great Britain and special types of cure have made an impact on the market in recent years. Following the introduction of self-service retailing, particularly over the past ten years, pre-packed bacon is increasing its share of the market and is estimated to account for about 10 per cent of the total bacon market. Although there has been an increase in vacuum-packed Danish bacon, most of the pre-packed bacon sold in this country is from United Kingdom factories and is said to account for about a third of total bacon production in Britain.

At factory level, two major developments have occurred within the past ten years. Firstly, there has been the growth of the heavy pig sector of the industry, or more specifically a return to and extension of the pre-war

Midland cure. Pigs are purchased at relatively heavy weights of about 10 score deadweight. The middles of the carcase, after trimming the rind and excess fat, are cured and distributed in pre-packed form. The remainder is used for bacon joints, some rashers for pre-packing, ham, a variety of manufactured products and fresh pork. The second and more recent development has been the cutting of the carcase of the traditional bacon pig of between 7 and 7½ score deadweight. Part is cured by the normal Wiltshire process and the remainder is used for fresh pork and for other meat products according to the requirements of the market.

Although Wiltshire tank-cured sides are still the predominant form of bacon produced, accounting for just over half the total bacon produced in Britain, there has nevertheless been a considerable increase in the number of pigs used partly for bacon. In the nineteen-sixties, pigs slaughtered annually at bacon factories in Great Britain have risen from less than four million to more than five million. However, the proportion of carcases used solely for bacon has fallen from 48 to less than 30 per cent and, at the same time, the percentage used partly for bacon has very nearly doubled to almost 40 per cent.

It seems, therefore, that the distinction between a Wiltshire bacon curing industry and the remainder of the pig processing industry in Great Britain is far less apparent than it was ten years ago.

Structure of the industry

Published figures relating to 1967* show that there were approximately 200 factories making returns to the Ministry of Agriculture, Fisheries and Food and, at that time, about 170 were in production. A feature of their structure, however, is the very large number which produce less than 100 tons of bacon annually. During the first nine months of 1967, nearly 45 per cent of the bacon produced in Great Britain came from only seven factories and a further 37 per cent from another 25 factories. More than 97 per cent of the bacon came from a total of 86 factories. The remaining 90 or so factories which produced bacon during this period accounted for less than three per cent of total production.

There was no obvious relationship between the size of the factory and the type of bacon produced and large factories were apparent in all sectors of the British bacon industry. There were eighteen factories producing bacon predominantly in the form of Wiltshire sides and these accounted for more than two-thirds of total production of that kind of bacon. Furthermore, six factories which produced no Wiltshire accounted for more than half all other bacon produced.

There appears to be an even greater degree of concentration in the ownership of factories. The relatively small number of factories which make such a major contribution to British bacon production are concentrated into fewer companies and it can be claimed that the production of bacon is very largely in the hands of ten or twelve companies or groups, all dominated by two large organizations.

******The Bacon Curing Industry*. **Report of the Committee of Enquiry into the bacon curing industry set up by the Economic Development Committee for Food Processing. National Economic Development Office. December, 1967.**

Distribution and marketing

Imported bacon is sold at first hand through agents to wholesalers or to large retailing organizations. However, only a small proportion of British bacon is sold in this way because factories in Britain have their own wholesale departments. They deliver both sides and cuts and, in some instances, packaged bacon direct to retailers. Moreover, some organizations have outlets in their own retail shops.

British bacon factories carry out, therefore, a large part of the functions of the wholesale distributor. In some respects, this is to the British curer's advantage because the wholesale function adds to the value of the product finally sold and thus should give him a greater margin of profit. On the other hand, it sometimes happens that a factory has bacon surplus to its immediate requirements and the bacon has to be sold at first hand. The price, then, tends to be lower because of the absence of regular first hand contacts.

A competitive industry

There is little doubt that in Britain the bacon industry, along with other users of pigmeat, operates in an intricately competitive situation. Competition exists at all levels both from overseas suppliers and from other buyers of pigs at home. The developments towards a more diversified production which have occurred in the British bacon industry in recent years have not lessened the intensity of the competition but have tended rather to strengthen them.

To obtain a better position in such a continuing highly competitive market the industry will need to make a steady effort to maintain and improve the quality, the consistency and the marketing of British bacon. Present indications are that the industry is already doing a great deal to this end.

In March, 1969, the Government announced that the Industrial Reorganisation Corporation would be examining the structure of the bacon curing industry. **Editor**

75th Anniversary of 'Agriculture'

Next month's issue will mark seventy-five years of publication of this journal. It will contain additional pages with specially commissioned articles on progress and prospects in agriculture.

P. J. W. Saunders

Barley Yellow Dwarf Virus in Cereals

J. K. Doodson

BARLEY yellow dwarf virus (BYDV), an aphid transmitted disease of cereals and grasses, is known to cause large yield losses in the U.S.A. and New Zealand. It was first recorded in Britain in 1954, and since then has frequently been recorded throughout the country.

Symptoms of the disease

The appearance of the infected plants varies with the crop, the variety, the type or strain of virus, the time of infection and the weather conditions. The most noticeable symptom is the discoloration of infected leaves. Leaves of infected barley plants turn bright yellow in colour, the tips of them turning yellow first. With later infections the flag leaf is often the first to discolour, followed by the older and lower leaves. This is in contrast to mineral deficiency diseases which generally cause a discoloration of the lower leaves first. Brown necrotic spots are often commonly associated with the yellowing.

Oat leaves may turn light green to tan colour when infected and then commonly become brilliant red to purple, standing out vividly in a green crop. In contrast, the effect on wheat leaves is not so striking; a red pigmentation may occur and the final result is a dull bronze discoloration.

Although black fungal moulds may be seen growing on the 'honey dew' deposited on the leaves by the aphids when feeding and crawling over the leaf surface, this is not a symptom of BYDV infection.

Infections which occur early in autumn and spring produce another distinguishing symptom, i.e., stunting and suppression of growth of the plant. Small patches of stunted plants may be seen in crops following heavy infestations with virus-carrying aphids. When ears emerge from infected plants they are smaller in size, and in oats the florets may be blasted.

Aphids convey the disease

BYDV is brought into the cereal crops by aphids. They feed on the sap of infected plants, pick up the virus, and may then transmit it when they next feed on healthy plants. They thus act as vectors of the disease.

Most strains of BYDV, particularly the more severe, are carried by the birdcherry aphid, *Rhopalosiphum padi* and the grain aphid *Sitobion avenae.* Several other aphids are also capable of carrying the virus and infecting cereal and grass plants.

The amount of BYDV being introduced into a crop depends upon two main factors, viz., a large source or reservoir of the virus on which aphids may feed, and the movement of large numbers of viruliferous aphids into the cereal fields. A survey of perennial ryegrass has shown that 93 per cent of the samples tested were infected with BYDV. It is thus reasonable to suppose that grass swards and leys upon which the aphids may feed are reservoirs of the virus. Severe yield losses are the result of early infection of cereal crops by large numbers of aphids. This can occur when early-sown winter crops are infected in late autumn or early in the following spring.

The recent succession of mild winters has been instrumental in allowing the aphids to survive over the critical winter period and they have therefore been able to invade crops in large numbers early in the season.

Yields are reduced

Varieties of wheat, barley and oats have been tested in replicated glasshouse and field tests for four years. Varieties were infected with a severe strain of the virus by placing viruliferous aphids on plants at early (G.S.2) and late (G.S.9) growth stages of each variety. The table below gives the percentage loss in yields obtained in field experiments of six winter cereal varieties infected on two different dates during the 1964/5 season.

Table

	Loss in yield due to BYDV infection	
Variety	*Time of infection*	*% reduction in yield*
Cappelle Desprez	Early	22
(Wheat)	Late	22
Camplein	Early	49*
(Wheat)	Late	40*
Dea	Early	39*
(Barley)	Late	29
Pioneer	Early	31*
(Barley)	Late	9
Peniarth	Early	51*
(Oats)	Late	38*
Pendrwn	Early	82*
(Oats)	Late	20

*indicates significantly lower yield than control (uninfected) plots at P = 0·05.

Oat plants, severely infected with barley yellow dwarf virus, show severe symptoms of stunting in comparison to the uninfected plants at the rear of the plot

In all cases considerable but variable losses in yield occurred and, with the exception of Capelle Desprez, larger yield losses were recorded with the early infection. Similar yield losses have been obtained with spring cereals although infection usually occurs later, with less effect on yields.

Reaction of varieties

Barley and oat varieties tend to be more seriously affected than wheat varieties, and the winter barley and oat varieties more so than the spring ones. Indeed, plots of several winter barleys and oats have been very severely stunted and failed to produce ears, and in extreme conditions, the plants in some plots were killed by the virus. In general, all barley and oat varieties may have their yields greatly reduced. The spring barley variety Cambrinus has been the only commercial variety to show some tolerance to this disease. Wheat varieties are marginally better because the effect on yield is not so drastic, although large reductions may occur, as with the variety Champlein.

Control measures

The choice of variety is immaterial because all are susceptible to this disease and may suffer losses in yield. Plant breeders have non-commercial material which exhibits good tolerance to BYDV but it will be several years before tolerant varieties are made available to the farmer.

The spread and severity of this disease is dependent upon the movement of viruliferous aphids in the cereal crops. Very cold weather and heavy rains in the autumn and winter reduce the aphid population and prevent the aphids multiplying in early spring. Prolonged frosts are particularly effective.

If the aphid carrier is killed the disease can be eliminated. The possible use of systemic insecticides to control aphids in cereal crops has been examined

in the U.S.A. and New Zealand. Increased yields were obtained when the crops were sprayed with these insecticides.

Preliminary small-scale spraying trials at the National Institute of Agricultural Botany in 1967 gave a mean increase in yield of 5 per cent for spring barley and 6 per cent for spring wheat. The systemic insecticide was applied at fortnightly intervals. In 1968 large drilled plots of Cappelle Desprez and Maris Quest were again sprayed at fortnightly intervals. The leaves of plants in the sprayed plots stayed green longer and meant that increases of 6 per cent in yield were obtained.

Until tolerant varieties become available, the use of systemic insecticides in controlling viruliferous aphids may be the most effective method of protecting crops from BYDV infection. Further investigations are required before a method of control using an insecticide spray can be judged an economic and efficient method of reducing the effects of this disease.

This article has been contributed by **J. K. Doodson, B.Sc., Ph.D.**, and **P. J. W. Saunders, B.Sc., Ph.D.**, who are respectively Plant Pathologist and Assistant Plant Pathologist in the Trials Branch of the National Institute of Agricultural Botany, Cambridge, where they have worked for several years on variety testing with BYDV.

This article summarizes British research findings on systems of

Slatted Floors for Fattening Cattle

Nigel Harvey

SOME farmers can fatten cattle in the cheapest of all forms of housing, which has grass as a floor and the sky as a roof. But not all farmers are as lucky as this. Some have to house their beasts in buildings. Traditionally, they have used yards; and traditional yards mean straw, which sometimes means money and always means labour. What has the slatted floor system, which needs no straw, to offer the beef producer?

There is, of course, no general answer to this question. It all depends on circumstances. But in recent years investigations at a number of different centres in this country have provided information which will help the individual farmer to answer it in his own particular way for his own particular needs.

Systems compared

Some of these investigations compared the performance of fattening cattle in straw yards and on slatted floors. Sometimes the cattle on slats gave slightly better performances than those on straw, sometimes slightly worse, and injuries to the cattle on slats were insignificant. From the point of view of production and animal health, therefore, there does not seem to be much in it either way.

Slat materials and design

Other investigations studied the detailed design of the system. The slats themselves presented few problems. There was general agreement that slats of top widths of 3–6 in. gave satisfactory results, though some preferred 4–6 in. as the cattle lay cleaner. There was general agreement that slats in cross-section should either resemble a 'T' or slope inwards from top to bottom as sharply as practicable and that slightly roughened flat-topped slats were preferable to bevelled topped slats.

There was also general agreement that the right spacing between the slats was 1½–2 inches. Softwood slats were not recommended as their lives were short, and there was some evidence that cattle were uncomfortable on steel slats. In principle, therefore, the choice is between hardwood and concrete. In practice, most farmers prefer concrete slats since they do not wear or warp.

In all cases, the importance of proper care in the laying of the slats was emphasized, for in poorly constructed installations the gaps between the slats were found to vary from 3 in. to nothing at all after the floor had been in use for some time. This tendency can be controlled by the use of 'hammer-headed' slats laid with the head-ends alternating or of separate spacers between the slats. If the latter are used, however, particular care must be taken in fitting them on farms where slurry is removed by vacuum-tanker, for experience has shown that an appreciable number of spacers work loose and fall into the slurry, where they become potential causes of pipeline blockage at mucking-out time.

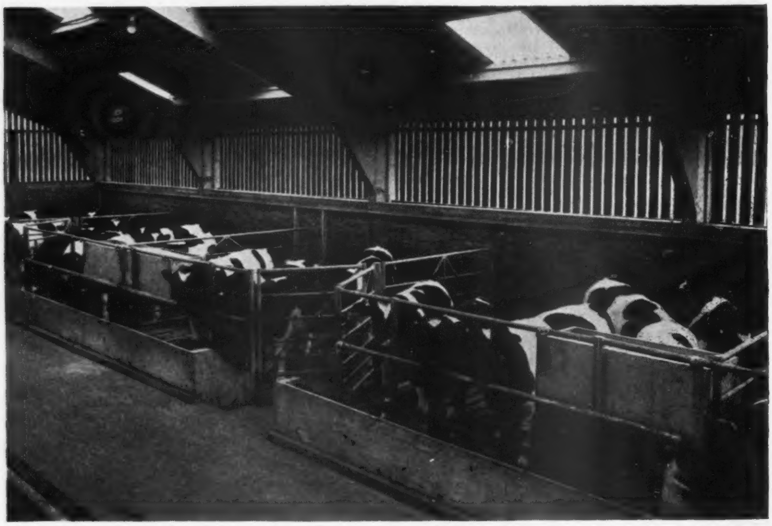
Manure storage and handling

There are two systems of storing and handling manure, the 'low level' in which the manure is stored in channels and handled as a liquid and the 'high level' in which it is stored in a deep cellar and handled as a solid.

Most of the farms which were studied handled the manure as a liquid, removing it from storage by a vacuum-tanker which spread it on the fields. In such cases watertight channels are, of course, essential, for if the liquids leak away, the channels will choke with solidifying material. Another essential is a level floor; otherwise residues will be left stranded at removal time. Equally important is the addition of water to the manure to secure an easy flow to the draw-off point and easy handling when it gets there. At least 6 in. of water is recommended. This should be put in the cellar before the floor is in use and manure starts to accumulate in order to create a 'float layer' of soft slurry under the general mass and prevent solid dung sticking to the surfaces as it would do if they were dry. Agitation of the slurry before emptying is usually advisable. Some types of tanker can do this conveniently at removal time by blowing air through it before removing a load.

The depth of low-level cellars is controlled by management decisions on the intervals between mucking-out and the storage capacity which this makes necessary. The most detailed figures given in the literature show that the monthly rate of accumulation of manure from bullocks varied from about $13\frac{1}{2}$ cu. ft per head at 7 months to 26 cu. ft at 13 months. Therefore, given the floor space per beast and making allowances for any water added and for the tendency for the accumulation of manure to be greater below feeding areas than elsewhere, storage requirements in particular cases can be calculated. A general rule-of-thumb of one foot of deposit per month per beast, plus the water added, seems reasonable.

The depth of a high-level cellar is controlled by the working height of the equipment, such as tractor foreloader bucket, used to empty it. A height of 8 ft 6 in. is recommended unless the slats are removed at mucking-out time.



Slatted floor pens for beef cattle at the Animal Husbandry Experimental Unit, West of Scotland Agricultural College

It is generally necessary to secure the removal of surplus liquid from such cellars. If this is not done, the manure is too soft to handle. One farmer found that a 1 ft layer of sawdust on the floor was enough to soak up sufficient liquid. Others, however, prefer systems which allow the liquids to drain through grids in the floor into pipes which carry them away to a holding tank outside the building. If these grids tend to block under the pressure of the manure, timber flues with sides of spaced boarding can be built above them so that liquid can seep through at various levels.

Stocking density

But, of course, the success of this system, as of any other system, depends on management as well as design and one of the crucial points here is the floor space per beast. There is a good deal of evidence on this point and various

trials have shown the harmful effects of overcrowding. For growing stock a floor allowance of 15–20 sq. ft per head appears reasonable, for fully grown stock 20–25 sq. ft per head.

One factor affecting decisions on the number of cattle to be housed is the possibility of making self-feeding silage on slatted floors. Here, however, a warning may be useful. Silage can certainly be made satisfactorily on such floors. Some farmers who did so first laid polythene film, paper bags or straw on the slats, but this was found to be unnecessary, for wastage at the bottom of the silage was negligible whether the slats were covered or not. But self-feeding on slatted floors presents difficulties, since trials have shown that at feeding time an appreciable amount of material, between 5 and 10 per cent, is dropped on to the floor. This loss can be halved by placing a plank or a shallow trough on the slats at the feeding face. Even so, enough can fall to block the spacings between the slats, so that manure collects on the floor instead of being trodden through, and to make the removal of manure by vacuum-tank difficult or impracticable by hindering the flow of slurry to the removal-point and choking the pipeline.

For the same reasons troughs for hay or silage on such floors should use 'Norwegian grids' or similar devices to prevent cattle pulling out large quantities of material and letting some of it drop. Anybody who has ever cleared a choked slurry pipline will realize the importance of such precautions.

Costs of the system

It is, of course, impossible to give firm advice on the costs of this system. So much depends on time, place, management and existing buildings. But it is possible to list the main factors which a farmer considering this system should assess in terms of £ s. d.

On the one hand, a slatted floor system houses cattle at less floor space and therefore, of course, less roof area per head than a conventional system and eliminates the need for straw and, with it, the cost of labour in handling it. On the other hand, it costs more per square yard of floor and may require new equipment for manure disposal. On balance, the advantage seems to lie with the slatted floor. Thus, one recent set of figures, based on new construction in both cases and making various reasonable managerial and financial assumptions, concluded that the total annual cost per head of a slatted floor system was about a third that of a solid floor system—£1 15*s.* 6*d.* to £5 7*s.* But it added, inevitably, that 'such calculations are approximate and could change somewhat according to circumstances'.

So you pay your money and you take your choice. Or, more accurately, you make your choice before you pay your money. The findings of the research workers may simplify the former and reduce the latter.

The writer wishes to acknowledge with thanks the assistance received from the West of Scotland Agricultural College in the preparation of this article

---

Nigel Harvey, M.A., Q.A.L.A.S., was a Farm Buildings Advisory Officer of the Ministry from 1946 to 1958. Since then he has been a member of the farm buildings staff of the Agricultural Research Council for whom he edits *The Bibliography of Farm Buildings Research.*

With skilled men becoming scarce, more automation in the feeding system of large dairy herds is inevitable, provided the capital investment is justified. **P. B. Harris** of *Bridget's Experimental Husbandry Farm*, discusses the developments in

Mechanized Feeding of Dairy Cows

UNTIL comparatively recently, the feeding of dairy cows has been far less influenced by mechanization than most other farming activities. The increasing need for labour saving in the industry has now, however, led to an increase in herd size and the establishment of large dairy units. This, together with the development of equipment which can handle the food materials available, has made the mechanized feeding of dairy cows both necessary and practicable.

Systems

Already several mechanized feeding systems have been developed, ranging from a fully automated system using tower silos with conveyors carrying the food to the cows, to the more flexible but more labour demanding method of filling trailers from a silage clamp with a fore-end loader and hauling these to the feeding area where they are mechanically emptied.

Siting of the buildings affects the system and to a large extent determines the choice between a forage box or a conveyor. Where a long distance separates the storage and feeding areas the former is likely to be more economic. On the other hand, a compact unit, with the use of mechanical conveyors, allows a system which is fully mechanized.

Silage and barley grain are the most easily mechanized for both harvesting and feeding. If the silage is to be stored in towers and extracted by machine, the physical nature of the materials assumes greater importance and cutting into short lengths and wilting to obtain a dry matter content of about 40 per cent is necessary. For such a system a high standard of management is required to provide a sufficient supply of fodder of the right physical quality and nutritive value, but it permits full mechanization of feeding.

Provision of a more reliable supply of a standard quality material, though of a lower nutritive value than grass silage, may be obtained by including whole cereal silage in the conservation programme.

Because, in a large dairy unit, individual feeding of all foods is not possible, probably the best compromise is to feed the silage, together with the barley, in bulk in the cowyards or cubicles. Subdivision of the herd should be possible into groups based on age, yield or stage of lactation so that they can be rationed and fed on a group basis. The more expensive concentrates can then be fed individually in the parlour at milking time, provided easy identification of the cows is possible.

Dairy unit at Bridget's

The system in use at Bridget's may be taken as an example. Established on a new site the dairy unit is compact with feeding mangers, which divide the cubicle blocks into four, not more than 150 feet in a direct line from the storage tower silos. This allows the use of a conveyor throughout, although a forage box is at present also used for feeding. Three silage towers allow comparisons to be made between different silage materials, weighing of which is possible as part or the feeding process. Together with two moist barley towers, storage is sufficient to provide for the 256 cows which will be housed on the unit, on the basis of 1½ tons of dry matter per cow for a 180-day winter.

Extraction from store

Extraction of silage from the tower is by a top-unloader of the chain cutting type discharging into an internal chute formed with metal plates as the tower is filled. This means that access doors and ladder are kept free of silage and the lined chute allows a free fall. The machine is suspended by a wire cable from the top of the tower controlled by a winch at the base. The load on the machine is indicated on an ammeter also at the bottom of the tower and adjustment of the winch made accordingly. Rates often quoted are of the order of 5–7 tons of silage an hour but the N.I.A.E. report of 1967 gives a range of 0·96–3·5 tons per hour for a number of unloaders investigated, the reduced output being due to underloading. Assessments made to date at Bridget's indicate an output of over five tons an hour of grass silage which increased to almost seven tons an hour when whole cereal barley silage was handled. In the more solid material at the base of the tower these rates are reduced.

Other forms of top-unloader deliver to an outside chute through the tower doors or to a central chute. Bottom unloaders can be operated as filling takes place allowing a 'first in, first out' process which is desirable when storage feeding all the year round. Access to the bottom unloader is easier for repairs and maintenance and moving the unloader from one tower to another, if required, is a much easier process.

Length of chop should be regularly just under one inch for efficient unloading and dry matter content and density of silage in the tower should be as consistent as possible. The latter can be achieved by efficient spreading, using a mechanical spreader, but the dry matter content of grass silage is dependent on the weather and management when the silage is made. Whole barley silage is more consistent in this respect. Moist barley grain can be extracted either by a top-unloader or bottom auger unloader the latter being used in a sealed tower.

Movement of these materials to a processing and mixing shed is by a chain and flight conveyor for the silage and by auger and elevator for barley grain.

Processing, mixing and distribution

All the silage entering the shed is batch weighed in a forage box chassis resting on four electronic load cells. A continuous type weigher would probably be quicker and result in less trouble from wads of silage. The barley grain is rolled mechanically and also batch weighed in a holding bin. This discharges into the silage conveyor by a calibrated auger when unloading takes place, to ensure proportionate mixing. Minerals are also added to the mixture by a vibrator placed over the conveyor, and other additions to the ration, e.g., extra protein could be made here.

Another chain and flight conveyor from the mixing shed takes the mixture to the conveyor feeder which distributes the food in the cubicle manger, a diversion board enabling the two halves of each cubicle, i.e., each group of 64 cows, to be fed separately. Several types of mechanical feeders are available but an important advantage of the one in use at Bridget's is that even and rapid distribution along the length of the manger is possible preventing bunching of the cows.

For comparative purposes distribution of the food is made to the second set of cubicles by tractor and forage box. This method appears to be slower than using the conveyor over the short distance involved, a skilled driver is required, and provision must be made in the building to allow for entry and turning; on the other hand, use is being made of equipment that would otherwise be standing idle.

The controls to operate the machinery are situated in the mixing shed except for the silage unloaders which are operated from the bottom of the towers. The whole system is in process of automation and most operations are linked by relays. It is intended that the whole mechanized feeding system will be controlled from the one switchboard and operated from the parlour.

Concentrate feeding

All concentrate feeding apart from the barley is carried out in the parlour when individual cows are fed on the basis of yield. The dairy nuts used are delivered in bulk to a 7-ton bin outside the parlour and taken by an automatic conveying system to feeders worked by hand from the herringbone pit. Operation of the system described has not been without trouble, conveyors have been blocked, especially with grass silage, breakdowns have occurred and some modifications of the equipment have been necessary. However, use of the system means that 120 cows can be fed with the silage and barley part of their ration in 40 minutes. When the full herd of 256 cows is housed and with central control of the automated system, the time factor can be reduced proportionately.

Two problems remain; the first is that assessment of the dry matter content of the silage, although necessary for rationing purposes, is not easy; the second is that cowmen may not have the necessary mechanical experience to handle such feeding systems without trouble. It is likely that this last, however, will solve itself in time.

It is anticipated that the use of mechanized feeding will reduce the work load and enable two men to milk, feed and handle the slurry from 256 cows, and still allow time for the necessary husbandry and stockmanship. With skilled men becoming more difficult to obtain and with wages continuously increasing, a move towards more automation in the feeding system is bound to come especially in the larger unit, but the capital investment has to be justified by careful budgeting beforehand.

F. W. Jameson

A. Rowlands

Improving Productivity and Profit on an Upland Sheep Farm

FOR many years the quality of enclosed upland pastures in Mid-Wales has been improving. Ploughing, drainage, lime and fertilizer applications and reseeding, including the use of leafy persistent herbage varieties, have all contributed to increased grassland productivity.

On farms where the enclosed land contributes most of the production, better herbage and grassland management has meant a better level of feeding for the sheep. This has also posed the question of how best to cash in on the grassland improvement obtained—whether to increase the size of the flock or make changes in breeds or systems. The answer will depend on the circumstances of the individual farm, including aspect, topography, possibilities of cultivation and availability of buildings. Experience on one upland sheep farm in Brecon illustrates some of the problems of intensification.

Blaenbwch lies on the northern slope of the Mynydd Epynt in North Brecon—155 acres of enclosed land on the edge of the Old Red Sandstone, with grazing rights on the adjacent open hill. Much of this is a War Department range comprising Nardus/Festuca dominant grazings interspersed with bracken-covered slopes. The farm runs from 1,100 to 1,250 ft, in an exposed position with a rainfall of 55 in.

Because most of the fields are very steep, haymaking is difficult and cattle tend to damage the swards in spring and autumn. The farm is, therefore, being run on an all-sheep system, but many of the principles which have marked the developments at Blaenbwch would apply equally to flock management on other similar farms where a mixed stocking policy is followed.

Since Messrs. Powell Bros. took over the farm in 1960 the thirty or so small fields have been reduced to seven blocks, now reseeded to mainly S.23 perennial ryegrass and white clover. During this time, the flock, mostly hill-type speckle-face of 80–85 lbs live weight, has increased from 200 to

750 breeding ewes with 150–200 ewe hoggs. This has been achieved by retaining ewes as long as they were productive. The performance of the flock over the last three years of this period is summarized in Table 1.

The poor performance of flocks run for the major part of the year on the open hill is now thought to be partly due to the generally low nutritional quality of the herbage throughout the summer. Such a poor summer diet can deplete the body reserves of the ewe at a critical time before and after mating, just as inadequate winter feeding does at lambing time.

The improvement in gross margin per ewe which has accompanied intensification at Blaenbwch has been due mainly to two factors. Firstly, full use is made of both the enclosed land and the hill at appropriate times of the year; secondly an adequate level of winter feeding is provided. The ewes come off the hill for flushing and tupping on pastures that have had a midseason nitrogen dressing. After they have settled to the rams, the mature ewes return to the hill for the rest of the winter. Feeding starts in January with a ¼ lb of whole maize per head per day rising to ¾ lb by early March. A fertilizer distributor is used to spread the feed on a flat part of the hill adjacent to the enclosed land. During periods of snow, when foraging is difficult, hay is sometimes fed as a supplement to the meagre roughage available.

The ewe hoggs are wintered on a block within the enclosed area on the same system. The cost of winter food works out at about 14*s*. per head.

The run-out to open hill makes all the difference to the intensive stocking of the enclosed land, for it allows the pastures to rest and therefore promotes growth in readiness for the young lambs, thus reducing the risk of a check. The rest period is vital also to the effective control of disease, which is always the biggest threat to any system of intensification.

The hill flock is brought down to the enclosed fields for lambing about 10th April. Last winter, 'self-help' feed blocks were introduced during the last weeks on the hill, and these remain on offer during and after lambing to supplement the grass. This was to overcome the tendency for ewes to leave newborn lambs when trough fed in bad weather. 'Aprille with his shoures soote' can mean snow or driving sleet in these Welsh hills. Hoggs return to the open hill in early May.

Table 1

	1965/6	1966/7	1967/8
No. of ewes	606	636	745
No. of hoggs	135	138	210
Stocking density (ex hill) ewes and hoggs per acre	5·3	5·5	6·6
Output per ewe	£4·95	£6·65	£6·75
Gross margin *per ewe	£3·2	£4·8	£4·6
Lambing %†	100	110	106
Fat lambs sold per 100 ewes	61	78	64‡
Average dead weight (1 lb)	29	30	28·5
Fertilizer costs per acre	£2·0	£2·1	£3·25
Units nitrogen per acre	10	40	46
Gross margin §per acre enclosed land	£15	£23	£25

Footnotes to table

*Gross margin relates to output less variable costs only, e.g., feed, medicines, forage costs.

†Lambing % relates to two-year old ewes and over, i.e., lambs weaned ÷ mature ewes put to ram. Hoggs and hoggs' lambs are excluded.

‡Due to a larger number of ewe hoggs retained.

§'Gross margin per acre' is based on 143 adjusted acres of enclosed land, with no allowance for the hill.

After lambing, the flock is divided into suitable groups (including one of ewes with twins—usually about 100) and set stocked until weaning, which takes place in mid to late July at about 14 weeks. The ewes then return to the hill, leaving the fields for the weaned lambs.

Most of the fields receive 40 units per acre nitrogen between March and May, a critical time when sometimes the grass never seems to grow fast enough. The next critical period is in early July, when fouling can be a problem. If possible, one or two fields are closed for a light cut of hay, or merely topped, fertilized and rested for weaned lambs. Since the reseeding programme was completed there is less opportunity to grow rape.

In the post-weaning period it is essential to maintain lamb growth. This has not been possible with all the lambs. Although selling usually starts by mid-September, there have always been lambs which do not finish off grass. When the store trade was depressed, these used to be carried until the following season, with the result that they competed with the ewes for grass. To discover how growth rate could be improved during late summer, three groups of lambs were weighed before and after a period of grazing three types of herbage. The daily liveweight gains obtained are shown below.

Table 2

Management of lambs after weaning—1967

	Liveweight gain per day (lb)	
	Singles	*Twins*
Lambs weaned on pasture not rested or top-dressed (8 lambs per acre)	0·08	0·10
Selected lambs weaned on to rape and reseed (10 lambs per acre)	0·18	0·23
Lambs weaned on to pasture top-dressed 50 units N in late June and rested four weeks (10 lambs per acre)	0·20	0·23
Performance of lambs during 40 days prior to weaning	0·30	0·25

All lambs were wormed at weaning.

Feeding whole maize to the ewe flock against the hill fence at Blaenbwch

The growth rate of the lambs on top-dressed and rested grass was equal to that of the lambs on rape and reseed, though they finished more slowly. The liveweight gain of the lambs that remained on the same untreated pasture, however, fell drastically.

At the end of both the 1967 and 1968 seasons about 70–80 store lambs remained. These were given a supplementary feed of barley or barley/beet pulp mix by running them indoors at night. They left a margin of £1 in 1967 and 13*s*. in 1968 over the estimated store value and feed cost; the last of them were sold in February.

Despite these possibilities it seems likely that about 30 lb dead carcase weight is the upper limit of the growth potential of the hill type speckleface lamb. It seems, therefore, that further improvements in output will have to come in other ways.

More ewes can create more problems. Overstocking could sooner or later result in a reduction of output per ewe due to unthriftiness. No one can tell at what density this will occur but at over six ewes and hoggs per acre the risks are obviously increasing.

During the 1968/69 winter, some 60–70 old ewes were retained and wintered in buildings, having been put to a Suffolk ram earlier than the rest of the flock. They were lambed indoors, bringing a lamb apiece. By extending for a further year the useful life of a proportion of the flock, this should reduce the number of hoggs required for replacement (which have to be wintered on enclosed land) and further ease the winter grazing problem. It would, of course, also reduce the number of two-year old ewes which need more feeding and shepherding than mature ewes.

It is possible that rams of better growth potential could be used. A compatible but larger hardy hill breed would increase the size of the ewes in the breeding flock and the average weight of lambs. In autumn, 1968, a Derbyshire Gritstone was given a trial with this end in view. A Down ram may also be used on that part of the flock not required for replacements, although this raises problems of hardiness of lambs and by itself does not solve the problem of the smaller wether lambs from the hill ewes that are bred pure for replacements.

In summary, the achievement of satisfactory margins from an upland sheep flock depends on good grassland management and maximum use of the enclosed land, a stocking rate suited to the farm and the hill grazings available, adequate winter feeding of the ewes, and a good standard of shepherding. It also needs a ewe with both hardiness and the potential to cash in on any improvements that can be made to the land.

Acknowledgment

The authors wish to acknowledge their debt to Messrs. Cyril and Glyn Powell whose ready co-operation over three years of grassland recording at Blaenbwch has enabled the material for this article to be collected.

This article has been contributed by **F. W. Jameson, M.A., Dip. Agric.,** who is Deputy County Agricultural Adviser for the National Agricultural Advisory Service in Brecon and Radnor, and **A. Rowlands, B.Sc.,** who is the Grassland Husbandry Adviser for the N.A.A.S. at the Cardiff Regional sub-centre, Llanishen.

The Production of Vegetables for Processing

V. D. Arthey

Christine Webb

OVER the past decade the demands of the fruit and vegetable preservation industries in Britain have led to changing requirements in both quantity and quality of supplies of raw materials. New methods of production and post-harvest treatment have been developed to meet these needs and concurrently to assist the grower to achieve the industrial specifications set by the canners and quick freezers.

Canners and quick freezers of agricultural crops are no longer the dumping grounds of surplus and second-grade raw material, and the most progressive growers have learned realistically that it is a much sounder insurance to plan their production of crops for known markets than to produce crops in ignorance of their final destinations. The processor, too, is glad to have the co-operation of a grower who plans to produce a crop to known specifications. This desirable liaison between producer and processor can only lead to a more amicable understanding of each other's problems and a greater tolerance of the lack of information which sometimes abounds. The partnership which results from this attitude tends to break down the farm-gate barrier over which many disputes and much distrust originated in the past, and allows the processing industry to have a planned programme from the production of the raw material right through to the presentation of the finished product on the shelf of the supermarket, chain store or the grocer's shop.

Thus the whole procedure becomes a united one in which the aim is to place before the consumers a product with such appeal and at such a price that they will return for more after their initial purchase.

There are many stages, however, between planning the production of the raw material and the appearance of the product on the shop shelf, and these stages are not always easy. Whereas the handling of the raw material within the factory has received much attention in the past, the agricultural and horticultural research centres in Britain have, until recently, devoted their attention mainly to problems related to the production of fruit and vegetables for the fresh market.

For some time now, methods of production of the same vegetables for different markets have tended to diverge. The processors' specifications have called for research into the best agronomic procedures for their markets, and likewise, the demands from the prepacking trade and fresh markets are for different varieties grown for specific qualities. At the same time the steady trend in the movement of labour from rural to urban areas, together with the high cost of employment, has necessitated the development and increased use of mechanical means of harvesting some crops which hitherto relied on teams of pickers to remove the crop from the field. Because mechanical harvesters work more speedily than a labour force the optimum stage of maturity of crops for a specific market must be known, since the correct determination of this will help to ensure the high quality of the article presented to the consumer. Mechanical harvesting requires the production of crop plants of certain habits which are produced at definite plant populations and field spacings. Many crops are now harvested entirely by this means, and in processing crops no better example can be quoted than that of garden peas, although dwarf beans also are now harvested entirely by machine.

Garden peas

The pea is still the most important processing vegetable grown in Britain. The crop is harvested from the end of June until the beginning of August. In general, the haulm is first cut and left in windrows for either collection and transit to a stationary viner, or for mobile viners to pick it up and shell the peas in the fields in which they were grown. Processors and co-operative growers now tend to prefer the use of mobile viners rather than static vining stations for many reasons. These include reduction of labour to operate the machines, cut haulm does not have to be transported from the field to the vining station and the spent haulm returned to the field, and more efficient cleaning machinery. This trend, however, has raised problems in the transit of shelled peas to the factory without undue loss of quality—problems which can be overcome by using modern methods of transport and up-to-date cooling systems.

The use of the principles of vining for shelling peas is a very old one; the first machine employing this method was described in 1885. More recently, a machine which picks pods from the pea haulm has been developed in the U.S.A. and tested in Britain. Unfortunately, the tests have not been very successful but if the method is pursued, a concurrent Australian development of a machine which shells peas from pods with much less damage to the pea, might be linked with the pea pod picker and so present the processor with raw material far superior in quality to that which has been possible hitherto by conventional vining methods. The resulting commercially canned, quick-frozen and dehydrated product would be more appealing to the housewife.

The use of mechanical means of harvesting crops demands a knowledge of the changes which occur in the edible portion of the plant as the crop matures.

The Fruit and Vegetable Preservation Research Association at Chipping Campden has long been associated with methods of measuring maturity, and it has been established that optimum maturity of peas is reached when a shelled sample of a raw material gives tenderometer readings of 100 and 120 for quick freezing and canning respectively. The tenderometer is an instrument which measures the resistance of a sample of peas to the shearing motion of a set of blades. Whilst optimum maturity is indicated by the figures quoted above, most processors cannot always achieve these values during the very hectic six-week period of pea production, and acceptable maturities will deviate from these values according to the quality standards of the factory concerned and the climatic conditions of the season in question. Thus optimum and acceptable quality specifications must be recognized even though the best prices are paid for the raw material which most nearly reaches the optimum values, and lower prices are paid for material which is harvested at the limits but within the values of acceptability.

To provide the factory with a continuous supply of suitable raw material at the correct stage of maturity, varieties which mature at different rates are used. The number of varieties of peas available to the canner becomes larger each year as more are proved to be suitable, and each processor is able to select varieties which most nearly meet his own particular quality standards. Canners prefer pale-seeded peas such as Surprise, Canners Perfection and Superfection. Dart is a new promising variety and Sprite has now replaced the dark-seeded Kelvedon Wonder. Freezers require dark-seeded peas and use varieties such as Sprite, Jade, Scout and Dark Skinned Perfection.

Broad beans

The mechanical harvesting of broad beans is a much more recent innovation. A few years ago this crop was harvested by employing a team of pickers. The picked pods were transported to the factory in sacks where they were shelled by vining in a specially adapted static viner or by a machine which squeezed the seeds from the pod. Some processors and growers now use a mobile broad bean combine which treats the crop in a similar way to peas. The method leaves much to be desired, however, in that considerable damage may be caused to the beans both physically and sometimes chemically. Again, the Fruit and Vegetable Preservation Research Association has been closely associated with the measurement of broad bean maturity and has established that optimum maturity of broad beans for canning is reached at a tenderometer reading of 140 (using a 5 oz sample of beans).

Varieties of broad beans for processing are not so numerous as those of peas. Only white-flowered stocks can be used for canning since those with coloured flowers contain coloured polyphenols which on processing cause the beans to turn a dirty brown. Triple White is the only widely grown variety for canning, and this variety is also used for freezing.

Dwarf beans

For processing, the dwarf bean crop is now harvested entirely by machine. The method employed is different from that for peas and broad beans in that dwarf beans are combed from the plants by metal fingers. The cleaning of the mass of harvested tissue is achieved in different ways, according to the machine, but the lighter material, including leaves, is blown out through the

top of the machine. The development of harvesters for this crop has necessitated changes in the varieties of dwarf beans used. Not only must the newer varieties produce pods which are straight and held off the ground, but, more important, all, or at least most of the crop, must mature at the same time thus allowing maximum collection of the beans at a single harvest. The most popular varieties for mechanical harvesting and high product quality include Harvester, Processor, Tendercrop and Sprite.

Unlike peas and broad beans, the tenderometer cannot be used to assess dwarf bean maturity. Work at Chipping Campden, which is still in progress, has indicated that a linear relationship exists between length of bean seed and maturity of the crop, and this provides a useful and simple measurement of maturity.

Carrots

The carrot has rapidly become the most important root vegetable processed in Britain. The tonnage canned in 1967 was 60 per cent greater than that produced in the previous year, and the total quantity is now approaching that for peas.

Unlike many European countries where the cylindrical Amsterdam Forcing type of root is preferred, only the inverted pyramid shaped Chantenays are canned in Britain, and it is on this type that field research has been concentrated. Better quality packs have been possible since the introduction of red-cored stocks of seed. More recently, better use of the grower's land has been made possible since the work at the National Vegetable Research Station and the Scottish Horticultural Research Institute has shown that carrots within the size range required by the canner can be produced in greater proportion of the total yield by giving careful attention to plant population in the field. Ideally, broadcast seed would be the ultimate aim but difficulties exist with this type of production; nevertheless, machines which sow bands of varying widths in which the seed is evenly scattered at a predetermined density are available. Carrots sown in wide beds are often difficult to lift but the harvesting of those in bands may be semi-mechanized, with hand labour still being used for some operations.

Brussels sprouts

It is only in recent years that attention has been focused on the mechanization of Brussels sprout harvesting. Traditionally this operation has always been carried out by hand and it is a particularly unpleasant occupation during the English autumn and winter months. Today, however, the delivery of trimmed sprouts to the freezing plant can be achieved almost entirely by mechanical means. Machines for the removal of sprouts from the plant stem have been in use for a number of years. They operate by employing rotating blades which cut the sprouts from the stem or by pulling the stem, top first, through a circular hole. Trimming of sprouts is usually achieved by hand but can be machine controlled. Until recently, sprout plants had to be cut in the field by hand, loaded on to a trailer and transported to the factory where the removal of the sprouts was done, but machines to make harvesting more fully mechanized are being developed.

Unlike the days when sprouts were picked over on several occasions by a gang of labourers, mechanical harvesting requires the plants to be grown so that the sprouts on a stalk mature at the same time. For quick freezing,

smallness of size may be achieved by the use of the right variety and by correct spacing. Evenness of maturity of all the sprouts on a stem can be encouraged by removing the tops of the plants soon after the sprouts appear in the axils of the leaves. The exact timing of decapitating the plants is still left largely to the discretion and experience of the fieldsman. Varieties grown for quick freezing include Jade Cross, Gravendeel, Sanda, Thor and Peer Gynt.

New potatoes

Although the production of canned new potatoes is relatively small when compared with the crops which have been mentioned previously, the product is of great interest since it is one of the newest canned single vegetable packs to appear on the home market. The success of this pack caused demand to exceed supply, a problem which is accentuated by the fact that not only do processors have difficulty in finding time to fit this new product into their annual timetable but more significantly by the lack of suitable raw material. The dearth of raw material has been partly due to the lack of information on the best means of producing to the specifications required by the processor. The acceptance of the new product by the consumer depends largely on its high quality, which is determined to a considerable degree by the suitability of the raw material.

For canning as new potatoes, tubers should possess a low specific gravity which ensures that they remain whole after processing and do not crack, slough or disintegrate. Tubers should also be small in size, passing through a $1\frac{1}{2}$-inch riddle and resting on a $\frac{3}{4}$-inch riddle, so that several potatoes can be filled into a can, especially containers of small dimensions.

The recent development of this crop for processing has meant that so far no specific machinery has been developed for either the planting or the lifting of the small tubers required by the canners. In some areas close planting of the tubers is achieved by using bulb planters, and on stone-free soils conventional potato harvesters can be used; the operation is difficult on stony soils since the machines are often set to allow stones to fall to the ground which are larger in size than the tubers required by the processor. Varieties currently in use for canning include Maris Peer, Arran Pilot, King Edward and Royal Kidney.

This paper has dealt only with the major or particularly interesting crops grown for processing in Britain. Many other vegetables are canned or quick frozen commercially; for example, asparagus, spinach and beetroot, and a great many more have been canned experimentally. As the trend in the demand for convenience foods continues, the consumer is likely to see more and more of the tedious preparation of vegetables being carried out by the commercial canning, quick freezing, dehydrating and prepacking industries and a consequent steady increase of high-quality, home-grown raw materials going to these preservation industries.

V. D. Arthey, M.Sc., Ph.D., is a Senior Scientific Officer and Agricultural Liaison Officer for the Fruit and Vegetable Preservation Research Association, Chipping Campden, Gloucestershire. **Christine Webb, B.Sc.,** is a Scientific Officer and is also engaged on agricultural liaison work at the Fruit and Vegetable Preservation Research Association.

Water in Agriculture

W. H. Hogg

THE XIIth Symposium in Agricultural Meteorology was held at the Welsh Plant Breeding Station on 19th March, 1969, and was attended by over one hundred persons, mainly from universities, Government departments and research stations. The subject was 'The role of water in agriculture', and the thirteen papers presented on widely different aspects of this theme provided a firm basis for the discussions which took place. It is impossible to do justice to all of these papers in a short report and the following account therefore concentrates on those aspects of the subject which appear to be of the greatest immediate importance in farming, particularly the use of water for irrigation.

The general ideas on which planned irrigation is based are by now widely accepted, and we think of a water balance sheet with entries on the credit and debit sides. The credit entries are rainfall, which is easily measured and, on the debit side, is entered the transpiration which can be estimated from other meteorological measurements; if a large debit balance results this can be corrected by irrigation, after allowing for readily available moisture which is stored in the soil. The accuracy of the estimates of irrigation need therefore depends on the reliability of meteorological observations and especially of rainfall. The standard method of measuring rainfall is to use a cylindrical gauge with its top 12 inches above ground level, and a diameter generally of five inches. It has long been accepted that in exposed areas, for example, on windswept moors, the wind may produce sufficient turbulence round the gauge to cause some of the raindrops to be carried away from the opening, thus leading to a loss of catch in the gauge and an underestimate of the rainfall. Recent work has shown that this also happens in less windy areas and specially constructed ground level gauges have shown increases from about 3 to 22 per cent over conventional gauges during a year or more, which clearly may be very important. From an agricultural point of view these differences are greatest where they matter least, in the uplands of the west and north but they could cause errors in the assessment of water yields of catchment areas that are made for reservoir design studies. In the south and east of England where there are heavy demands for water, the average underestimate of rainfall during April to September is around 4 per cent which represents about half an inch. It is, of course, also true that errors

arise in estimating transpiration rate but neither these nor the rainfall measurements invalidate the method as a practical farming aid. Taken together they give answers which are more accurate than the present methods of irrigation with standard equipment.

Although the principle of using water balance sheets is simple, in order to obtain the best results some adjustments have to be made to the basic model outlined above. For example, the transpiration from a standing crop varies not only with the weather but also with the proportion of ground cover provided by the crop and allowance can be made for this. An important point to be remembered in using the method is that once the soil is at field capacity any excess rain or irrigation water is wasted in relation to the crop and is lost either by runoff or drainage. It follows from this that irrigation cannot benefit a crop unless there is already a soil moisture deficit.

The use of water balance sheets assumes that when there is a soil moisture deficit, subsequent rainfall or irrigation will reduce this until field capacity is reached. For this to happen infiltration must be unimpeded, but some recent experiments have suggested that, when herbicides are used to produce an artificial surface for the convenience of farmer or grower, there is a very low infiltration and this leads to a permanent reduction in the water in the soil which is available to the plant.

Water balance sheets may be used as a guide to the timing and amount of irrigation during the current season; they can also be computed retrospectively to give more generalized information on the likely needs over a period of years as a basis for planning. An atlas showing the long-term needs in map form has recently been prepared for England and Wales and this emphasizes the large quantities of water which would be required if crops were supplied with sufficient to keep the soil close to field capacity throughout the growing season. If it is not possible to provide the full quantities of water, it is imperative that any limited irrigation should be applied at a time which will produce maximum benefit. Recent work has shown that we may think of moisture sensitive stages of growth, and experiments with peas have demonstrated that, provided the soil is near to field capacity at the time of sowing, irrigation at any time between sowing and the start of flowering does not affect the yield of edible peas, though it greatly increases the vegetative growth of the plants. Irrigation when the flower petals have begun to open not only increases vegetative growth but also the yield of peas by 30 per cent; at the end of flowering, when the petals have shrivelled, further irrigation has no effect on either vegetative growth or pea yield, but if water is given as the pods are swelling, the yield is increased by a further 20 per cent.

Early summer cauliflowers are sensitive to water shortage at any stage of of growth and, to obtain the maximum size of marketable curds, the readily available moisture in the root zone must not be depleted by more than 25 per cent. In central England this involves watering about once a week in dry weather and this gives the maximum yield, but almost as large a yield results from a single watering just before cutting begins. With early potatoes at Efford full irrigation gave a yield of about 12 per cent above that for limited irrigation but costings showed a higher profit per acre with the latter.

In some ways irrigation may be regarded as more important for perennial crops such as fruit trees and bushes than for annual crops, because any loss in growth may become cumulative over the years. Conversely, any improvement in the environment of a crop that prevents a check, or favours a gain, in growth increases the photosynthetic capacity and may lead to a cumulative

improvement in cropping. In a six-year experiment on unpruned black currants, irrigation increased the growth of wood by an average of nearly 50 per cent and cropping by an average of more than 60 per cent. The progressive increase of yields of the watered compared with the unwatered bushes was particularly interesting; from about 20 per cent in the first cropping year it rose above 100 per cent in the fifth year. If the bushes are pruned in the second year, the crop responses to irrigation are reduced, but a cumulative effect is again apparent.

With top fruit, experiment has shown that irrigated trees grow faster than those that are not irrigated and the yield differences show a true cumulative effect of irrigation on cropping, although with some delay in response which is due to the time necessary for the stimulated shoot growth to develop fruit buds and to crop.

There are, of course, many uses of water on farms besides the irrigation of outdoor crops. These are principally drinking water for livestock, milk cooling, cleansing of cows, utensils and dairy premises, washing down in cowsheds and yards, crop spraying, frost protection and irrigation in glasshouses. However, from a national point of view, the total demand for water for agriculture, other than irrigation, is small and is distributed rather than concentrated. It is probable that agricultural demand is probably rising and that it will continue to do so in common with industrial and domestic demands. The quantities of water required per acre for irrigation are far greater than those needed for livestock and dairy enterprises and in some circumstances it is economically impossible to obtain sufficient water for large areas of low value crops.

The passing of the Water Resources Act of 1963 is leading to many changes in relation to the future conservation and control of water resources in England and Wales. While the abstraction of water is now prohibited without a licence, river authorities are required to take action to redistribute or augment water resources in their area so that demands may be met. In the drier parts of the country, the demand for irrigation water in the growing season may lead to the limitation of the abstraction to the winter months so that storage may be necessary for the whole irrigation season. This will certainly reduce the incentive to irrigate grass, sugar beet and cereals, but the cost of a reservoir is not likely to be critical for higher value crops. To some extent it will be offset by the lower charges for water in the winter.

The papers presented at this symposium will be published in permanent form later in the year and this will provide a valuable record of experience and research on many aspects of water in agriculture, of which only a few have been discussed in this report.

The author of this article, **W. H. Hogg, M.Sc.,** is the Senior Meteorological Officer attached to the Ministry's office at Bristol, covering the South Western and West Midland Regions and Wales.

Is herd expansion really necessary to increase profits to the desired level? Haydn Davies of the National Agricultural Advisory Service discusses some business aspects of

Dairy Herd Expansion

THE most significant trend in milk production in recent years has been the progressive increase in herd size. If the current economic climate continues, herds will in all probability continue to increase in size.

Such herd expansion consumes capital. This capital might be borrowed or withdrawn from personal resources. Regardless of source, it is highly desirable that the increased profit, resulting from the expansion, is sufficient to justify the capital expenditure.

It is somewhat disappointing to report that recent case budgeting of proposals for herd expansion on the predominantly family run farms in North Cheshire has drawn attention to a surprisingly large number of instances where budgeted increases in profit were insufficient to warrant the proposed capital outlay. The purpose of this article is therefore two fold; firstly to consider the lessons emerging from these Cheshire case studies: secondly to urge the plea that all herd expansion proposals be forward budgeted to determine whether they are financially worth while.

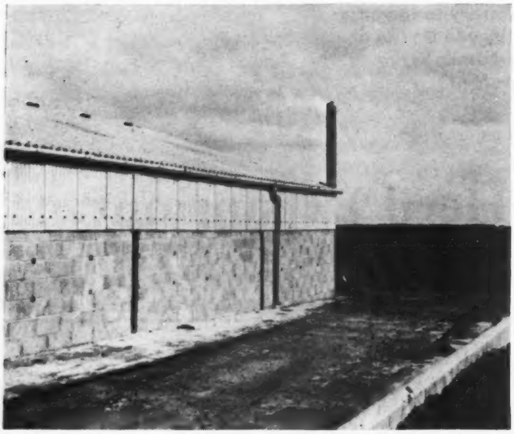
Financial return

The usual business measure of the value of an investment is the percentage return on the capital invested, i.e., the average annual increase in profit expressed as a percentage of the capital required to secure the increased profit. Money invested in herd expansion should be no exception to this measure.

In agriculture generally, investments are normally only considered worth while where the annual return is likely to be at or in excess of 15 per cent. The minimum acceptable return will however differ with circumstances. For example,

1. where there is an unduly high risk element, either in terms of technical risk, or in the uncertainty of the foreseeable market for the commodity, one should be looking for a return of at least 20 per cent;
2. where the invested money is borrowed, the shorter the stipulated repayment period the greater has to be the return on capital if the repayment has to be met by the extra profit.

Herd expansion is a marginal activity. The result of this is that investment risk is relatively low since future performance ability can be based, within narrow limits, on known past performance. Also, future milk prices have, until recently, been confidently predictable. A combination of these two factors has led to the general acceptance of a 15 per cent return as being the threshold of acceptability for a dairy herd expansion.



A steel-framed, asbestos roof cubicle house; a covered silo will shortly be built on to one end

Cheshire experience

A summary of the investment analysis of twelve proposals for herd expansion over the last 18 months is given in the table on page 386. Six of the twelve cases yielded a budgeted return on capital in excess of 20 per cent. Three cases gave budgeted returns on capital of between 18 and 19 per cent. Three cases yielded budgeted returns of less than 10 per cent. In summary, therefore, nine of the twelve cases investigated were considered to be worthwhile financial investments. *What is probably of greater significance is that of the eight cases involving a change from a shippon to a yard-and-parlour, only five were considered worthwhile proposals.*

The technique used in all twelve cases was the relatively simple method whereby the additional return was related to the additional capital required (return on 'marginal capital'—see reference on page 388). The return was calculated using the gross margin technique, making of course suitable adjustment for any changes in fixed costs, including building and machinery depreciation.

Factors associated with financial return

The rate of return on capital is influenced by a multiplicity of factors. An analysis of the twelve cases studied (see table on page 386) indicated the following factors, either individually, or more commonly in combination, to be the major factors influencing the rate of return.

Capital cost of building works. This is probably the most important single item. Usually, the highest budgeted returns were obtained in cases where building costs were the lowest, i.e., through the conversion or extension of existing buildings into shippon accommodation. The lowest budgeted returns were usually obtained where expansion also entailed relatively large-scale building works involving a conversion from a shippon to a yard-and-parlour system. Eight of the twelve cases were in this latter category and returns varied from eight to 31 per cent. Building costs per *additional* cow housed (net of grant) in these eight cases varied from £48 to £176 per cow. Where conversion or extension of existing buildings into shippon accommodation

was undertaken (four cases) the cost per additional cow housed ranged from £17 to £78.

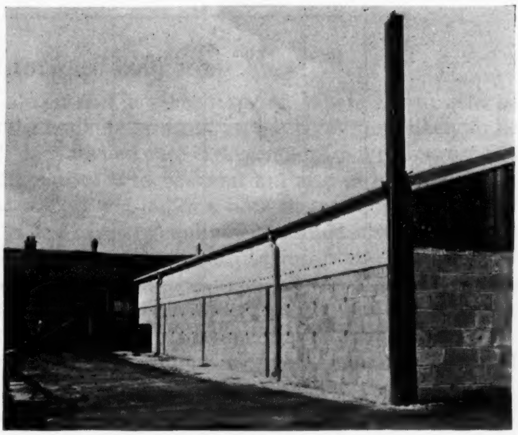
Fortunately, the farmer can exercise considerable control over building costs. Much can be done to keep these to a minimum by:

1. using existing buildings where they can be reasonably adapted;
2. using cheap timber structures, as opposed to more expensive steel or concrete structures for housing the cows;
3. using open as opposed to roofed silos. (Much here will, however, depend upon local conditions of exposure, rainfall and possibly calving policy. The system of manure handling also has a very important bearing in this respect);
4. doing the work on a direct labour basis and using the farm staff as much as possible;
5. choosing a cheap and simple system of muck or slurry handling;
6. obviating the cost of a milking parlour by batch-milking in an existing shippon. This, because of the greatly increased time and effort spent in milking can only be recommended as a short-term expedient. A better long-term but relatively low-cost alternative is to use a stationary milking bail suitably converted.

Magnitude of the herd expansion. The greater the number of cows the capital investment can be spread over, the lower the unit cost, and the greater the return on capital. From the cases studied, it appeared that, in general terms, a 50 to a 100 per cent increase in herd size was necessary to justify changing from a shippon to a yard-and-parlour.

Effect on regular labour requirements. Where expansion necessitates employing an additional man, with average cow performance, another fifteen to twenty cows will have to be kept solely to meet the man's wages. Where employed labour can be permanently dispensed with, and this is often the case when converting to a yard-and-parlour, then considerably more capital can justifiably be spent on fixed equipment; e.g., where a £800 a year man is dispensed with, approximately £5,000 can be spent on new building works.

Economic performance of the cows. The better this is, the greater the increase in profit, and consequently the greater the return on capital. Alternatively, for a given return on capital, the greater can be the expenditure on buildings or machinery.



The cubicle house in the photograph on p. 384 from the opposite end

Case budgeting data for 12 farms in Cheshire

Nature of additional housing	Case No.	% Return on capital	Proposed increase in herd size	Building costs per additional cow housed (net of grant)	Farm organization requirements
				£	
1. Conversion of existing buildings to shippon accommodation	1	48	38–53	23	Lose 10 acres corn and improve stocking rate from 1·6 to 1·4 acres per cow
	2	31	46–60	17	Lose 20 acres of corn and maintain stocking rate at 1·3 acres per cow
2. Shippon extension	3	40	13–23	76	Improve stocking rate from 1·7 to 1·2 acres per cow
	4	19	19–34	78	Lose 17 acres corn and improve stocking rate from 1·5 to 1·3 acres per cow
3. Conversion from shippon to yard-and-parlour	5	31	48–100	102	Give up corn growing and improve stocking rate from 1·3 to 1·0 acres per cow
	6	29	36–70	113	Give up corn growing and heifer rearing and improve stocking rate from 1·2 to 1·0 acres per cow
	7	19	63–90	67	Lose 34 acres corn and maintain present stocking rate at 1·2
	8	19	25–45	48	Lose 5 acres potatoes and 20 acres of corn
	9	18	30–56	81	Give up corn growing and improve stocking rate from 1·4 to 1·1 acres per cow
	10	9	36–60	169	Lose 6 acres of potatoes and 24 acres corn, maintain stocking rate 1·2 acres per cow
	11	9	50–75	176	Lose 30 acres corn and maintain stocking rate at 1·2 acres per cow
	12	8	30–50	110	Lose 20 acres corn and 6 acres potatoes

Relative profitability of the additional cows with the enterprise(s) they are replacing. Obviously a better case can be made for increasing cow numbers at the expense of relatively low profit enterprises such as cereals or livestock rearing rather than high profit enterprises such as potato or sugar beet growing. This was the major reason why case No. 12 gave such a poor return on capital. Here an extra 20 cows at £65 gross margin per acre (£1,300 total G.M.) were replacing six acres of early potatoes at £100 per acre G.M. and 20 acres of barley at £29 G.M. (£1,180 total G.M.). Since the potatoes and cereals have very low fixed costs (secondhand machinery and casual labour is used for the potatoes and much of the work on cereals is done by contract) then the G.M. figure of £1,180 is largely profit.

Additional machinery requirements. Herd expansion involving a change from hay to a silage system can often tie up large amounts of capital in silage-making equipment, more powerful tractors and possibly slurry handling equipment. Such was the position with case No. 11 (9 per cent return) where almost £1,300 would be tied up in converting from hay to silage-making.

Circumstances vary greatly between two farms—*it is therefore essential that each case be given wholly individual consideration.* It should always be a guiding principle that the more capital invested in extra cows and the less in buildings and machinery, the greater will be the return on the capital employed.

Non-financial considerations

These can be particularly important on family farms. Here overcoming hard physical effort or drudgery is frequently as important as financial considerations. In this context, a yard-and-parlour has much to offer. Where such considerations are accepted to be of greater importance than financial return, every effort should be taken to ensure that the expansion is of sufficient magnitude to spread the cost of new buildings and machinery over as many cows as possible.

Well designed yard-and-parlour layouts are often very good inducements to maintaining or attracting employed labour. This can be particularly important in areas where good labour is difficult to come by.

Other advantages of forward budgeting

Forward budgeting is also useful in other respects. Where a loan is to be raised, particularly from the banking institutions, money is more likely to be forthcoming where a well documented case is presented. Such people are not only interested in how the money is to be spent but also in how quickly it can be repaid. A forward budget will indicate both these requirements.

A realistic projection of the capital requirement should also ensure that sufficient capital is raised to ensure that the expansion is taken through to the planned number of cows in the planned time. All too often in practice insufficient capital is budgeted for, with the result that intended cow numbers are not attained in the planned time. This means that either a further loan must be negotiated or the deficiency in number of cows must be purchased from profits. The latter course can be an extremely slow process. Consequently the repayment period on borrowed money is often greatly increased.

Failure to capitalize fully on money spent on fixed equipment and machinery is very bad business.

Further considerations

The application of business appraisal techniques should not end with the completion of the expansion programme. Ideally, a system of budgetary control should be instigated to ensure that the assumptions of the forward budget are actually being achieved. In practice, all that merely need be done is to measure herd milk output and concentrate use periodically, since these are the main factors affecting profitability. This can conveniently be done under monthly recording schemes. Budgetary control is particularly important with a change from a shippon to a yard-and-parlour. This not only involves a big change in feeding and cow handling techniques, but also often results in a high proportion of new cows of unknown past performance entering the herd.

Probably the most important necessity of all, when considering a herd expansion proposal, is to determine whether herd expansion is really necessary. It might be possible to increase profits to the desired level solely by improving the performance of the existing herd, e.g., by improving stocking rate, more economic use of concentrate feed, or reducing herd replacement costs.

Reference

The return is the increased annual income, less depreciation costs due to additional building works and machinery, and loss of income due to any displaced enterprises. Any changes in regular labour charges are also allowed for.

The 'marginal capital' is the capital required for the additional cows, building works (net of grant) and machinery, less any capital released in running down displaced enterprises. Since one is only dealing with marginal income and marginal costs, budgeting is, therefore, kept to a minimum.

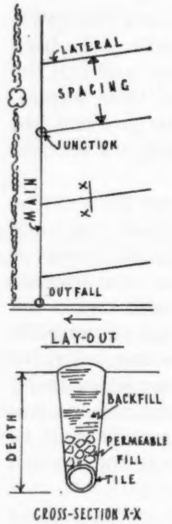
Every effort was made when constituting the budget to use figures of the farmers' own past performance. This was considered essential since in milk production financial performance can vary tremendously from farm to farm. A conscious effort was also made to 'write into' each budget the financial consequences of any technical changes associated with this expansion.

This article has been contributed by **Haydn Davies, M.Sc.**, who is a District Agricultural Adviser for the N.A.A.S. in the West Midland Region.

'Agricultural Education'

Details of a new range of courses in agriculture and horticulture are given in the latest edition of 'Agricultural Education', the free illustrated booklet issued by the Department of Education and Science.

Copies of the booklet are available free from the Department of Education and Science, Curzon Street, London, W.1. (Telephone No. 01-493 7070).



Underdrainage terms

A sound design carried out with good workmanship, under dry conditions, will result in an efficient underdrainage system only if it is maintained properly. The author, R. H. Miers discusses the

Development of Underdrainage Design (Part 1)

THE bases of art are a matter of opinion, the bases of science are a matter of fact. Is underdrainage an art or a science?

The dawn of underdrainage at the end of the eighteenth century was founded on the work of Joseph Elkington who, using a sound knowledge of geology, developed the interceptor system which prevented flat land and the lower slopes of hills being waterlogged by water issuing from springs. This method ensured the maximum amount of benefit for the least expenditure but was not the complete answer to ponding which occurred on heavy land.

At the beginning of the nineteenth century the thorough tile-drainage system became popular in dealing with this impermeability problem. Every part of the field received the same treatment irrespective of the need. The system was apparently so easy to apply that science was abandoned and every drainer formed his own unfounded opinions on how underdrainage should be carried out. With very little regard to the drainage problem some drainers laid laterals deep, whilst others believed in shallow systems.

Tiles of many shapes were popular—horseshoe, rounds, eggshaped, funnelled, and 1 in., 2 in., $2\frac{1}{2}$ in., 3 in. and even 8 in. Permeable fill was placed by some drainers under, and by others over the tiles, whilst in some cases it was used without any 'pipe' at all. Laterals were laid across or down the slope without due consideration being given to the effect of gradient, whilst spacing varying between 5 and 14 yd seems to have been adopted by drainers without regard for the soil or the problem. Underdrainage had become an art and so it has remained until recently in spite of the efforts of several engineers and surveyors to codify the bases of design. Towards the end of the nineteenth century, Wheeler, the eminent land drainage engineer, laid down tile-drainage spacings based upon soil texture, but subsequent experience has shown that much wider spacings were often successful, and that spacing could not be related to the texture of the soil.

British civil engineers have for upwards of 100 years ensured the water-tightness of dams and canals by using a puddled clay. It ought to have been evident that the treading of the wet clay changed its character and that the permeability of a soil was dependent upon factors other than texture. Similarly, everyone in agriculture has seen ponding where cattle have poached the surface or the tractors have left their track marks. Why does the permeability of the soil change when it is compacted?

In a massive clay, where there is no aggregation, the space between the particles is likely to be less than 0·0001 in. across, a space which is so small that water cannot move in it under the force of gravity. If underdrainage is to be effective there must, therefore, be some much larger passages through which water can percolate. Soil has structure, and permanent cracks are part of that structure; it is also known that roots and worms aid permeability by making holes through which water can pass. By compacting a soil the cracks and holes are destroyed and in many textural classes the permeability also. If, therefore, the passage of water through a soil is dependent upon cracks, and the importance of the cracks is related to texture, it must be possible to relate underdrainage design to crack development and the feel of the soil.

By studying the development of cracks in the Humber warps and on exposed faces of Keuper Marl Pits, a definite sequence was found to be followed. Whilst the deposits were still wet and unchanged they appear to be massive—a state where there is no aggregation of particles and water can pass through the mass only very slowly, if at all. If, however, the deposits are laid down in different depths of water and whilst currents of different velocities have been flowing, the particle sizes vary slightly and, when drying out begins, cracks occur parallel to the surface, inducing a horizontal permeability.

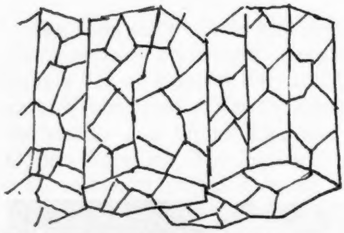
Further drying out causes a contraction of the soil as a whole, resulting in vertical cracks not unlike those found in the Giant's Causeway. These help the passage of water in a vertical direction and allow the circulation of air.

This circulation of air tends to cause the soil to dry out unevenly, that nearest to the crack contracting fastest, and the penetration of roots down the cracks accelerates this process, which causes further cracking into an angular blocky pattern which increases still further the horizontal and vertical permeability.

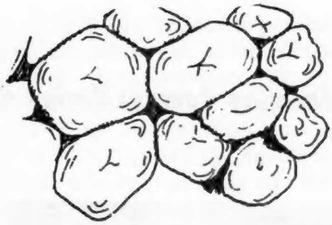
At this stage weathering has completed its task and biological activity continues the crack development by smoothing off corners and wedging open the cracks with organic and mineral complexes.

Platy cracking with some horizontal permeability

Prismatic cracking with some vertical and horizontal permeability



The formation of angular blocky pattern of cracks accompanied by an increase in vertical and horizontal permeability



The rounding off and widening of cracks by biological activity

Finally, the soil can develop still further into crumbs and granules and it reaches its greatest permeability, but this is rare below the top soil.

Permeability can therefore be said to increase with crack development from massive through platy, angular blocky, sub-angular blocky patterns. This is, however, over simplification, as the pattern may be more widely or narrowly spaced, and in some soils the cracks will be narrow and in others wide, whilst some cracks are unconnected and others continuous. It is evident that permeability increases as the space between the cracks becomes smaller, and when the cracks are uninterrupted by adhesions.

Whilst the roots of farm crops require aeration, aquatic plants can thrive under annaerobic conditions and very often form stabilized channels where their roots have died. Especially in association with platy structure, a soil permeability is created which is not associated particularly with texture or structure.

The three physical characteristics of soil can be considered together in relation to permeability, the width of the cracks being described by the ease with which the soil breaks.

Soil characteristic		← Permeability → Decreasing … Increasing
Texture		Clay, Silty clay, Loam, Sandy loam, Loamy sand, Sand
Cracks	Pattern	None Platy Prismatic Ang. Blocky Sub Ang Blocky
	Distance between cracks	Narrow Moderate Large
	Width of crack	Difficult Free Open
Biological activity		No voids 3% voids

Before the physical characteristics of a soil can be related to the soil it is essential to decide if depth or spacing is the most important criterion.

Part 2 of this article will be published in the October issue

This article has been contributed by **R. H. Miers, M.B.E., B.Sc., A.M.I.C.E., M.I.Agric.E., A.M.I.W.E.**, a Regional Engineer with the Ministry of Agriculture, Fisheries and Food at Lincoln.

26. Leicestershire

S. E. Turner

LEICESTERSHIRE, a relatively small county with rather less than half a million acres of agricultural land, was traditionally known for its undulating grassland, its leafy hedges, its beef cattle, the hunting pink of its famous packs including the Quorn, the Belvoir and the Fernie, Stilton cheese and Melton Mowbray pies, the scenic beauty of Charnwood Forest and its general air of pastoral peace. Whilst much remains, a great deal of the pastoral green has now been replaced by the browns and golds of arable farming. Leicestershire today is very much a county of mixed farming and many farms still carry a multiplicity of enterprises. Of recent years, however, economic pressures have been forcing an increasing degree of specialization. Situated as they are between the predominantly arable eastern counties and the dairying and livestock areas of the west, Leicestershire farmers are influenced by both. Consequently two main systems are evolving—arable (mainly cereals) with a ley acreage devoted to fat lamb and beef production; and dairying usually combined with cereal growing.

The soils are variable but generally tend to be heavy, hence the pre-war dominance of permanent grassland. Most of the centre and south of the county lies on Boulder clay and Lower Lias clay—often intermixed. On the eastern side, approaching the Lincolnshire borders, the Lower Lias is replaced by Middle and Upper Lias and one or two of the higher ridges are on Oolitic limestone. The ironstone soils of the Middle Lias and the limestone soils, although limited in extent are free draining and easy working and are cropped more intensively with arable crops than in other parts of the county. The northern part is somewhat mixed but much of the area is on Keuper Marl with an overlay of drift material of varying depth and textures. In the North West an appreciable area lies on the Coal Measures which give rise to heavy clay soils basically low in phosphate. There are, however, patches where Millstone Grit comes to the surface or where the clay is overlain with Keuper Marl or sand. Near the Derbyshire border there are a few small outcrops of Carboniferous Limestone, and at Breedon-on-the-Hill Magnesian Limestone is still quarried in considerable quantities. Charnwood Forest lies north west of Leicester between Coalville and Loughborough, and in this area there are frequent rock outcrops (Pre Cambrian) and the soil is poor and shallow, overlying granite with many stones and boulders near the surface. Most of the fields are enclosed by dry stone walls. In the valleys of the three main rivers running through the county—the Soar, the Wreake and the Welland—are alluvial deposits which generally give rise to deep, fertile soils.

Since the ploughing up campaign of the war years cereal production has continued to play a major part in the farming of Leicestershire. In 1968, slightly more than 40 per cent of the agricultural area was under arable crops and of this area 90 per cent was cropped with cereals. The heavy land of the county is ideally suited to growing good wheat crops and as it is the most profitable cereal crop, Leicestershire farmers prefer to maintain as high a wheat acreage as practicable within the limits imposed by weather conditions and rotational hazards. Statistics show that wheat normally comprises about one third of the cereal acreage.

Leicestershire remains, however, predominantly a livestock county and has long been famed for the quality of its fatstock. One of its best known farmers was Robert Bakewell of Dishley Grange, Near Loughborough, who in the latter half of the eighteenth century gained enduring fame for his work in connection with the breeding and feeding of livestock.

Whilst systems of cattle and sheep production are many and varied some mention should be made of the famous Leicestershire fattening pastures. These are situated in the valley of the River Welland centred on the town of Market Harborough and extending northwards to the five Langton villages. They are used to summer fatten purchased store cattle (mainly Irish) and very high liveweight gains from grazing are obtained even without recourse to inorganic fertilizers. To maintain the production from these pastures a high level of grassland management has been maintained over many years and careful matching of stock to grass growth is essential. In fact the success of the graziers has been due to their traditional skill in stock buying and the skilful management of their grassland. However, even the Welland valley is turning brown as the Market Harborough district increases its cereal acreage each year.

FROM THE A L S

A Better Way

P. S. Pepper, *Agricultural Land Service, Newcastle*

THREE routine jobs on a commercial pig enterprise were examined during practical exercises following a one week's appreciation course in work study. At first sight it was evident that these tasks could be carried out in a better way with useful saving in time and effort.

The first job that was examined in detail was the twice daily cleaning out and feeding of 560 dry sows. These were tethered in individual stalls in five separate houses. Forty-two sows and six boars were housed in converted individual sow feeders in six service areas. Five sties and twenty-four loose boxes housed a further fifty sows. The total jobs took a team of five workers some 18 man-hours daily.

On the job of cleaning out, examination after recording and the construction of a multiple activity chart showed that, though the workers were very efficient and skilled, their efforts did not turn out to be properly co-ordinated.

Dung was cleared out twice daily. The need to do this was questioned because the amounts were only small at each cleaning and there did not appear to be any hazard to health involved. The management agreed that it was only necessary to remove the dung and clean thoroughly once a day and the implications of this point were, therefore, carefully considered in detail.

By logical thought and critical examination, using the multiple activity chart and developing ideas it was found that a new method could reduce the team to two men working more effectively and the total time could be cut to five hours. No additional equipment would be required to achieve this, merely a few modifications. The simplest was shortening a broom handle to permit a full and easy sweeping action instead of a restricted, difficult method that a long handle made necessary. It was also suggested that a midden should be constructed to eliminate any handling of dung loading into a wheeled trailer at high level. This would not only reduce manual effort and strains, but would also mean that the normal farm mechanical equipment could load and cart away the dung at less frequent intervals and release the trailer for use elsewhere. The workers could also complete their tasks in an easier way.

In the feeding routine, management required the sows to be fed $5\frac{1}{2}$ lb of a home-milled pelletted food in two equal feeds each day. Examination of the existing system showed that there was considerable waste. For instance the trolleys were of unknown capacity and were filled with an unknown quantity of food from a bulk feed lorry. The sows were fed an approximate quantity from a scoop of unknown capacity.

Measurement of the amount of food actually fed showed that this was in excess of management's requirements. Obviously if scoops holding $2\frac{3}{4}$ lb each could be used then accuracy and consequent food saving would be achieved.

The amount of food left at the bottom of the trolley indicated that the home-mixed pellets used were somewhat 'soft' and much wastage was caused through powdering. One of the recommendations made was that the pellets themselves should be made 'harder' to reduce this cause of wastage.

The second job to be looked at was feeding and cleaning in Danish type farrowing and weaner houses. These consisted of twelve timber buildings each having thirty pens. Feeding was done from a trolley and food was thrown on the floor to the sows and weaners in the pens. Each house took about ten minutes to feed and though this would be difficult to improve upon a number of small points emerged during the recording and examination stage. Collectively these small points would produce savings in both the time taken and the amount of food fed.

A chart was prepared showing a method of rationing for daily feeds of between 4 and 15 lb of food per pen, bearing in mind that in some cases the morning feed was greater than the evening feed. Volumetric weighing and the provision of two scoops, one of 3 lb and one of 2 lb capacity were suggested to avoid using a special $2\frac{3}{4}$ lb scoop. It was fundamental to the success of this idea, that the different scoops should be easily identifiable and a means of doing this was devised.

So far as cleaning out was concerned a small modification to pen troughs, fixing some water bowls and adjusting the position of the longest board forming the creep pen would considerably ease the cleaning out operations. It was also found that a steel shovel was being used. If this could be replaced by a shovel made of aluminium or an alloy it would be much lighter and of greater capacity. At least one third as much more dung could be lifted at once with ease. Adaptations to the dung barrow itself were recommended to prevent side spillage when cornering and thus avoid the necessity for passageway sweeping after each cleaning out operation.

The third job to be examined was feeding some 1,700 pigs ranging from seven to twenty-four weeks old housed in three Dutch barn structures on the kennel/open yard principle. Two men were employed to feed these pigs. *Ad lib.* feeding was practised using circular metal hoppers with eight feed points per hopper and three hoppers to each yard which held about one hundred pigs. Pelletted pig food was delivered daily in a bulk lorry with a single sack-filling outlet. Sacks were filled singly and whilst one man filled, the other transported and emptied them, one at a time, into feed hoppers. Because of the design of the pen troughs this man had to climb over a 4 ft high metal-work fence or block wall at each pen, then receive a bag of some 60 lb weight and walk amongst the pigs carrying this to get to the hoppers. Before the hoppers could be filled it was necessary for them to be turned up and cleaned out. This was essential because they rested on the straw bed and the majority of the feeding points were bunged up with straw and dung.

It was recommended that a multi-outlet bulk lorry with a self-emptying container be constructed. This would fill six hoppers on one wall of the yard raised slightly above yard level. Only twice a week filling would be necessary and this would reduce the labour by 50 per cent, the distance walked by 240 miles a year and the time taken from 78 minutes daily to 11 minutes twice a week, not forgetting the amount of time and frustration which would be avoided during cleaning out. Other recommendations on the improvement of ventilation to the kennels, and minor modifications to the pen troughs, were also made.

Twelve course members, led by three fully-trained work study officers, having looked at these routine jobs on a large pig enterprise for less than four days, indicated where savings of up to £5,000 per year were possible by the application of method study.

Report on Farm Dairy Buildings

THE 'Report of a Working Party on Farm Dairy Buildings' 1969 just published by H.M. Stationery Office (price 2*s*. 6*d*.) has set out in precise terms what should be regarded as good dairy practice, bearing in mind the need to make the best use of capital and labour to achieve economic clean milk production. New techniques, heavier stocking densities and larger herds have called for more buildings for the dairy herd. If these are properly designed they should easily meet statutory structural requirements and help hygienic methods.

The Report reminds us that four-fifths of the dairy herds in England and Wales are still milked in cowhouses. These are reviewed by emphasising the importance of correct siting, structural detailing, ventilation requirements and muck removal methods, etc. Particular attention is given to the merits of 'dry' cowsheds, 'flush' systems beneath gridded dung channels and internal trapped gullies, which are all matters which have been known to give rise to problems.

Relay milking is a cowshed and the conversion of cowsheds to milking parlours are examined as are free standing parlours and bails. It is made clear that bails and prefabricated parlours and milk rooms on fixed sites should satisfy the same conditions as conventional milking parlours and milk rooms.

Integrated dairy buildings in which cows are housed, fed and milked under one cover is a modern trend which can cause milk hygiene problems, so it is not surprising that a section of the Report makes a particular effort to reach a balanced view on this score. Straw yards, cubicles, slats and manure storage tanks are all reviewed, while particular attention is paid to lighting and ventilation and the removal of wastes from dairy buildings. The need for physical separation of the milking area from the remainder of an integrated building is examined in some detail. A series of drawings are helpful in illustrating the text.

The Report has taken the Milk and Dairies Regulations into account without in any way attempting to interpret them.

in brief

- **Looking into root growth at Letcombe**
- **Bought calves**
- **Children on the farm**

Looking into root growth at Letcombe

THE Agricultural Research Council's Radiobiological Laboratory was established at Letcombe, near Wantage, in 1958 primarily to study the contamination of agricultural materials and particularly foodstuffs by radioactive substances. Since then, however, when the greater part of the work there was devoted to the study of of plant root systems, especially in relation to their nutrition, the original name 'Radiobiological Laboratory' is no longer entirely appropriate. In future, therefore, this establishment will be known as the Letcombe Laboratory, although it is emphasized that there will be no change in the overall programme of the Laboratory, which will continue to carry out such investigations as may be required on the contamination of agricultural products. The same basic mechanisms control the movement of nutrient ions and radioactive contaminants in plants and the soil, therefore work on the behaviour of fission products is in many ways closely allied to work on some aspects of root performance and nutrition.

The Laboratory's Annual Report for 1968* pays special attention to this particular field of investigation. Heavily compacted soil is inimical to plant growth—hence the need for ploughing. But more recent demonstration that crops, especially cereals, can sometimes be grown successfully for several years with the minimum of cultivation if weeds are controlled by herbicides, has stimulated renewed interest in the effect of the physical conditions of the soil on root growth. Where there is mechanical impedance, plants develop shallower root systems, with many side branches and abundant root hairs, but nutrient uptake per unit volume of root nevertheless appears to differ little from that where root growth is unrestricted. Contrary to expectation, the absorption and translocation of some nutrients, e.g., phosphate, occurs just as readily in the older parts of the roots of cereal plants as in the younger parts, provided that the outer tissues of the root are undamaged.

A technique using radioactive rubidium–86 has been developed at Letcombe and is now used in field studies of the distribution of roots in the soil. Rubidium–86 is injected into shoots and becomes sufficiently uniformly distributed throughout the living roots of young plants for the volume of roots in different zones in the soil to be inferred by measuring radioactivity in soil cores.

Bought calves

THAT it pays to shop around is particularly true when buying calves. It is all too easy to buy trouble. The prospective calf buyer needs to look for robust youngsters with good weight for age and certainly not less than a week old. They should not have toured several markets or collecting centres, nor been held on premises that are never empty of calves. Any evidence of scouring, discharge from eyes, nose or mouth is sufficient to justify rejection; as also are thickened navels or any *hint* of other infection.

---

*H.M. Stationery Office, price 12*s*. (by post 12*s*. 6*d*.).

The second stage is to get the calves back to the farm immediately in a clean, well-strawed truck; handle them gently and don't overcrowd them. Warm, dry and well-bedded pens, disease-proofed by thorough disinfection, should be ready waiting for them; and ideally each calf should have a pen to itself for at least the first fortnight. Installed in their quarters, they will need a rest of two hours or more before feeding, which for the first twenty-four hours should consist only of warm water (3 pints) and glucose (3 oz). Thereafter, for the next two or three days feeding should be built up *gradually* to a normal ration.

The best plan, of course, is to buy from only one, reliable source, but where calves have to be bought from a number of places the precautions to avoid the risk of cross-infection must clearly be stepped up. An all-in, all-out system of management, whereby only one age group is kept and the houses vacated and disinfected at the same time is essential.

Gleadthorpe practice

At the N.A.A.S. Gleadthorpe Experimental Husbandry Farm, Mansfield, Notts, calves for their beef enterprise are usually bought in three batches of 55—at the end of August, mid-October and mid-February. These are commonly Friesian male calves ranging in weight from 80 lb to 120 lb, specifically managed for experimental purposes. Five weeks are allowed for rearing the end-of-August batch, which allows two weeks for house cleaning and disinfection before the second intake in mid-October. These in turn are safely weaned before the onset of winter, and the houses again thoroughly cleaned, disinfected and rested before the February intake.

On arrival at Gleadthorpe the calves are bucket-fed on glucose and water and given an injection of vitamins A, D_3 and E. Dung samples are also taken for identification of Salmonella organisms, and any calf found to be infected is promptly isolated from the remaining animals. The second feed is also glucose and water, after which dilute milk substitute is introduced and the strength and quantity of subsequent feeds gradually increased until four days after arrival calves are getting 12 oz of milk substitute in 5 pints of warm water as a single daily feed given in the morning. (Once-a-day feeding of milk substitute is now standard practice at Gleadthorpe.) Hay, dry concentrate and water are available to appetite from the start.

Children on the farm

SCHOOL holidays spent on farms, a new world for town children which invites exploration and adventure, can hold tragedy unless the farmer and his staff are constantly alert to forseee what might happen in apparently the most innocuous circumstances. The same consideration also applies to country children—perhaps even more so, since familiarity can dull the edge of caution. The high degree of mechanization on our farms today inevitably fascinates young, inquisitive minds and tempts probing fingers. 'What happens if you press that button?'. 'What's in this can?'. 'Let's go and see what's inside!'. These could be preludes to a life-time of regret. A ride on a tractor or some other farm machine may be exhilarating for a child (although against the law), but a farm is not a fairground, and town parents accompanying their children on country holidays should understand that farm workers have their jobs to do and are not specially trained wardens. Yard and harvest field are the workshops of farming and as such carry dangers in their business. The farm can offer an enjoyable and health-giving holiday. Make it also a safe one.

AGRIC.

Books

Second Nutrition Conference for Feed Manufacturers. UNIVERSITY OF NOTTINGHAM. Edited by H. SWAN and D. LEWIS. Churchill, 1968. 24*s*.

These conferences, usually held annually, are designed to concentrate on issues of particular interest to feed manufacturers, and publication of the deliberations is always keenly awaited. The proceedings comprise the full text of the set papers given by selected speakers, usually with a comprehensive bibliography, followed by an edited account of the observations and questions raised by members of the audience. This Conference held in March, 1968, consisted of four sessions, two of which were devoted to problems of fat utilization, one to the use of non-protein nitrogen in feeds and protein quality, and the final one, to problems of mineral imbalance and the effects of mill processing on vitamin levels in diets. The 'fat' session included papers on the principles of fat utilization; the selection of commercial fat sources for use in livestock feeding; possible adverse effects of oxidized fat; and mill problems of dietary fat inclusion.

The wide range of topics involved approaches that ranged from fundamentally academic to practical and technical; in short, the whole gamut of interests of personnel engaged in the animal feeding-stuffs trade. Each paper provided a useful compendium of knowledge of the chosen topic and as such will serve as a valuable starting point for those who wish to pursue such topics in greater detail. Skilful editing has made the whole work, papers and discussion, extremely readable. This book, modest in both price and size, can be warmly recommended as a mine of information relating to the topics covered, and deserves a place on the book-shelves of all those whose interests lie in the broad field of applied animal nutrition.

A.E.

Price Premiums for Quality Beef Steaks. *Report No. 11*. DEPARTMENT OF AGRICULTURAL MARKETING, UNIVERSITY OF NEWCASTLE. 1968. 15*s*.

This report, one of a series on meat marketing, deals with an experiment in retailing conducted to find to what extent consumers would pay higher prices for better quality beef steaks. Experiments in economics are rare but they are potentially of great value and should be encouraged. This one illustrates the problems they raise, particularly those of holding constant the factors in the immediate situation other than those under examination, and of obtaining results relevant to a variety of economic situations.

In this experiment the immediate situation was controlled to a considerable degree, with active co-operation from the meat department of a large supermarket. For two types of steak, 'frying' and 'porterhouse', the price of the ordinary grade was held at the store's commercial level whilst the price of the higher grade was increased progressively. The higher quality frying steak was distinguished from ordinary by longer hanging in the supermarket's chill-room and its appeal to consumers lay in its presumed greater tenderness. The higher quality porterhouse steak was trimmed, resulting in a reduced area of visible fat. These two quality differences, tenderness and visible leanness, are of interest.

Every day a sample of each quality of frying steak was measured as to tenderness and it was found that the higher quality steaks were not significantly more tender than the ordinary quality. Which is to say that 'quality' in this case was something not certain to be realized by the butcher's customary method for producing it, and something the consumer could not verify when purchasing. In contrast, greater visible leanness of better quality porterhouse steaks was in fact achieved and to a degree which previous studies suggested consumers could differentiate.

The report analyses in detail for each type of steak the effects on quantities demanded of changes in the ratio of the prices of the two grades. The information yielded can have great importance for store management, although it is subject to many qualifications. It would be worth while the store obtaining higher quality steaks and selling them at a higher price if the total value of sales increased by more than any additional costs.

Analysis of the experimental results concerning frying steaks suggests the total value of sales would have been maximized if no differentiation had been made between

ordinary and higher quality. The conclusions the report draws from this are unsatisfactory. It pays inadequate regard to the fact that in the experiment the higher quality frying steaks were not more tender, and that the results are not necessarily applicable to the sale of more tender steaks.

For the porterhouse steaks, with their lesser or greater degree of visible leanness, the experimental results of consumer responses to price differences suggested that total sales value would be maximized by selling higher quality steaks at a higher price. Consumers apparently preferred leaner meat and were prepared to pay for it when the difference in leanness was distinguishable.

The results of this relatively small-scale experiment relate to the particular circumstances of a self-service store in North London. The characteristics of the population using it are not known, although it is recorded that when best porterhouse steaks were priced at 15*s* 6*d*. a lb some 28 lb were still sold in a week. Comparable experiments in other economic situations might be expected to show differences due to consumers' incomes and tastes in meat as regards type, cut and quality, to methods of retailing, and so on. An experiment of this sort inevitably has limitations, such as often result in a deal of difficult work for a little sure evidence. But that does not detract from its importance; rather are those responsible to be thanked for their initiative. Without the painstaking collection of evidence such as the department at Newcastle has undertaken, there will never be a body of knowledge, as opposed to opinion, about the economics of marketing.

A.V.V.

The Daffodil and Tulip Year Book, 1969. The Royal Horticultural Society. 30*s*.

The gulf between the specialist or daffodil exhibitor and both the commercial producer and general gardener continues to widen. While acknowledging this regrettable fact the R.H.S. succeeds, if not to bridge the gap, to cater for many diverse interests. Several of the twenty-six articles have an historical theme, notably one tracing the pedigree of the pink 'Romance' back over eight generations and another discussing the influence of the old *maximus* on modern daffodils. One of the two articles allotted to tulips also refers back to tulips in ancient Turkey. Wholly contemporary is the account of the planting technique which has enabled Rosewarne Experimental Horticulture Station to minimize labour while achieving accurate experimental results, which have proved so valuable to the commercial grower but which are so largely ignored by the 'specialist'.

The major part of the year book is, however, written by connoisseurs for connoisseurs and includes accounts of exhibitors' achievements in England and elsewhere, notes on the 1968 season, analyses of prizewinning cultivars and descriptions of promising new ones. For 'galanthophiles' there is a chapter on growing snowdrops. The usual complement of daffodil records is included and, not least, a generous quota of admirable illustrations.

K.H.J.

Plant Growth Regulators. (S.C.I. Monograph No. 31). Society of Chemical Industry, 1968. 70*s*.

This bound volume contains the text, with accompanying discussion, of seventeen scientific papers presented at a symposium organized jointly by the Pesticides Group of the Society of Chemical Industry and the Phytochemical Society, held in January, 1968. They were prepared by an impressive collection of experts from five countries.

Plant growth regulation is an active area of contemporary research, fed by the twin impulses of the desire to understand the complexities of the natural systems of control of growth by the plant, and the desire to modify plant growth to human advantage.

The naturally occurring growth regulators include the auxins, gibberellins, cytokinins, abscisic acid and ethylene—all of which are mentioned in this book. There are papers on their detection and identification and on the part they play in inhibiting growth, imposing seed dormancy, and controlling flowering, fruit development and senescence. Some papers deal with the related effects which can be produced by synthetic compounds.

It must be stressed that this book contains detailed papers reporting research. Emphatically, it is not a book to browse through lightly, nor does it provide complete reviews on the present state of knowledge. There still remains a pressing need for a book to bring the non-specialist up to date on this fascinating topic.

K.H.

The Role of Potassium in Agriculture. Edited by V. J. KILMER, S. E. YOUNTS and N. C. BRADY. American Society of Agronomy, 1968. $8. (65*s*. 4*d*. Approx.)

This is an excellent book. It contains the proceedings of a symposium held at the National Fertilizer Development Center, T.V.A. Muscle Shoals, Alabama on June 18–19, 1968, and was published only a few months later.

Although not claimed to be exhaustive, it provides an up-to-date account of world resources of potassium, the technology of fertilizer production, the properties of fertilizers containing potassium, the mineralogy and chemistry of soil potassium, the evaluation of potassium fertilizers, the biochemistry and role of potassium in plants, animals and man and the potassium requirements of the principal crops of temperate and tropical agriculture.

There are twenty-two chapters, each written by different authors of which there are twenty-eight, drawn from industry, technical institutes, universities and extension services in many parts of the United States.

Each chapter is a technical and scientific paper of high quality, well documented with references, in some instances up to 1968. The literature surveyed is mostly that of the past thirty years. A fair part is from outside the U.S. and includes a number of papers from Britain.

There is no doubt that this book is of text-book quality and will be a source of information on potassium to people in the fertilizer industry and to teachers, advisers and research workers in agronomy, soil science and crop nutrition, in many parts of the world.

N.H.P.

Profitable Pig Farming. GEOFFREY JOHNSON. Farming Press, 1968. 36*s*.

This third edition is a major revision of Mr. Johnson's book originally published ten years ago. It passes on, for the benefit of students and practical pig producers alike, the systematic approach which has ensured the profitability of the author's own large-scale pig enterprises over the last thirty-five years.

The opportunities for reducing costs of production and increasing output with the minimum of housing is dealt with in detail. In view of his enthusiasm for high throughput it is, however, a little surprising that he should continue to support traditional eight-week weaning.

The author has not only a wealth of experience to back up his recommendations but also the results of continuing trials carried out on his own farms. This enables him to expound with confidence on those methods of breeding, feeding, housing and husbandry which he has developed and which have been adopted by others with similar success.

His criticism of organisations and schemes of which he does not approve is balanced by a readiness to give credit where it is due. He is an exponent of artificial insemination, hysterectomy and the Pig Health Control Association, in all of which he has played a leading role as a breeder of pedigree and commercial stock.

At a time when many pig producers are contemplating the expansion or reorganization of their pig units, this book provides a business-like approach to their problems, combined with invaluable practical hints which are so important for the successful execution of day-to-day management. In view of its comprehensive nature, there must be few producers who could not, with advantage, implement some aspect of the advice given.

G.A.M.

Environmental Conservation. (2nd Edition). RAYMOND F. DASMANN. John Wiley and Sons, 1968. 80*s*.

Climate, geology and the activities of man are the three major factors in the shaping of our environment, and the relationship between them forms the theme of this book.

The author gives a fascinating, historical account of the changes brought about by agriculture and forestry. For thousands of years such change was gradual, allowing nature time to absorb and adapt. Over the last hundred and fifty years, however, change has been rapid and often far-reaching in its effects as a growing world population applies science to the provision of its needs.

The fundamental problem is clearly explained as the difficulty in closing the gap between the knowledge and practice in managing natural resources. The knowledge exists but there is little power to apply it. The importance of education towards understanding is emphasized because it should lead to enlightened planning, legislation and management.

Although this work is described as a text-book, its presentation and clarity make it compulsive reading. Those who own and manage land are reminded of their responsibilities in the broader context of the global issues involved. It is unfortunate that the text is not well served by the diagrams and drawings, which are often cramped and awkward in style. Two of the figures are unnumbered and captionless. A glossary to explain some of the technical terms used, and greater consistency in the use of Latin names for species, would have helped.

Minor errors include giving the responsibility for National Parks in Britain to the Nature Conservancy and not the Countryside Commission. No mention is made of the voluntary ban on the use of aldrin, dieldrin and heptachlor operated by farmers in this country; one of the significant pointers to the ultimate success of conservation which depends on the co-operation of us all.

In this revised edition we are brought up to date with the many advances in conservation since the first publication in 1958 and this book should continue as a classic for those who are concerned with the world around them and its future.

M.J.W.

Early Agricultural Machinery. MICHAEL PARTRIDGE. Hugh Evelyn, 1969. 63*s*.

This review of some of the machines developed in Britain during the late eighteenth, nineteenth and early part of the twentieth centuries is attractively presented on thirty 13¾ in. × 9¼ in. pages, supplemented by sixteen colour plates, three of which illustrate two implements, and four reproductions of original engravings. The fairly simple illustrations are well executed, and convey an adequate and pleasing impression of the general arrangement of the mechanisms of the implements and machines portrayed.

The book must be regarded as a work of art rather than as a comprehensive attempt to portray the development of agricultural machinery, because of its limited scope. There are twelve short sections about the development of the plough; land drainage; harrows and other cultivation implements; the seed drill; haymaking machinery; Patrick Bell and the reaping machine; threshing machinery; fodder machines; portable steam engines; John Fowler and the steam plough; rotary digging machines; and early motor tractors. Most of these are too short to cover the subject in detail and, from a technical viewpoint, some sections, e.g., that on early motor tractors, are disappointing as there is no reference to machines as important as those illustrated.

Inclusion of both black-and-white and coloured photographs of the same subjects seems particularly wasteful of space when so little of the ground is covered.

Nevertheless, it is the kind of book which many farmers and engineers who are interested in the past will like to have, if only for the pleasure of looking at the pictures.

C.C.

Mineralogy in Soil Science and Engineering. (S.S.S.A. Special Publication No. 3). Edited by G. W. KUNZE, J. L. WHITE and R. H. RUST. Soil Science Society of America, Madison, Wisconsin, 1968. $3.50. (28*s*. 7*d*. Approx.)

This book, which publishes papers given at a symposium held during the 1967 annual meeting of the Soil Science Society of America, covers the relationship between the mineralogical composition of soils and soil properties and use. It contains five papers but only two of these dealing with soil physics and soil chemistry are likely to be of direct interest to those concerned with the agricultural use of soils. The way in which physical properties such as soil structure, swelling, shearing resistance, water retention and hydraulic conductivity are affected by mineralogical composition are clearly treated in a 35-page paper 'Mineralogical Data Requirements in Soil Physical Investigations' by P. F. Low. A 40-page paper by C. I. Rich, 'Applications of Soil Mineralogy in Soil Chemistry and Fertility Investigations' deals with the way the properties of different soil minerals affect the reactions of cations and anions in soils, ion selectivity, and trace element reactions and then proceeds to a brief discussion of the role of soil minerals in providing nutrients for plants.

The other shorter papers, probably of less interest to agriculturists, are 'Engineering Applications of Soil Mineralogy' by H. F. Winterkorn, 'Applications of Soil Mineralogy to Soil Classification Investigations' by R. J. McCracken and 'Trends in Mineralogical Analyses' by W. F. Bradley.

G.B.

books received

Farm Business Statistics for South East England. Supplement for 1969. Copies from the Dept. of Agricultural Economics, Wye College, Ashford, Kent. 4*s*. 6*d*. (including postage).

Ministry of Agriculture, Fisheries and Food

Farm Guides 1969. Terrington and Bridget's Experimental Husbandry Farms.

Annual Report 1968. Efford Horticulture Station.

Field-by-Field Guide to Crops and Investigations 1969.

Copies may be obtained from the Farm Directors.

Oxford Farming Conference Report 1969. Copies from Mr. M. H. R. Soper, Dept. of Agricultural Science, University of Oxford, Parks Road, Oxford. 12*s*. (including postage).

Rothamsted Experimental Station Report for 1968. Parts I and II. Copies from The Librarian of the Station, Harpenden, Herts. 30*s*. for both parts. (20*s*. for part II only).

Annual Report 1968. Plant Breeding Institute, Cambridge. 10*s*. 6*d*. (including postage).

Annual Report 1968. (ARCRL/19). Agricultural Research Council. 12*s*.

Annual Review 1968-69. Eley Game Advisory Station, Fordingbridge, Hants.

The Ministry's Publications

Since the list published in the July, 1969, issue of *Agriculture* (*p*. 337) the following publications have been issued.

MAJOR PUBLICATION

Smallholdings organised on the basis of Centralized Services Rpt. Report and Accounts for the year 1967-68 submitted by The Land Settlement Association Limited. (New) 3*s*. 3*d*. by post 3*s*. 7*d*. (*Not for re-sale*.)

FREE ISSUES

ADVISORY LEAFLETS

No. 10. Fruit Tree Red Spider Mite (Revised)
No. 11. Winter Moths (Revised)
No. 196. Turnip Gall Weevil (Revised)
No. 279. Skin Spot and Silver Scurf of Potatoes (Revised)
No. 307. Root-knot Eelworms in Glasshouses (Revised)
No. 484. Glasshouse Symphylids (Revised)
No. 502. Scarlet Runner Bean (Revised)
(Formerly Dwarf and Climbing Beans in the Open)

SHORT TERM LEAFLETS

No. 55. The Uses of Beans in Stock-Feeding (Revised)
No. 89. Real Controlled Environment for Poultry (New)
No. 72. Weed Control in Horticultural Brassicas (Revised)

Single copies of the above free items are obtainable from the Ministry (Publications), Tolcarne Drive, Pinner, Middlesex.

Agricultural Chemicals Approval Scheme

Fifth List of Additions to the 1969 List of Approved Products for Farmers and Growers.

CUFRANEB
Wettable Powders
Blitzblight—Amoco

DALAPON
Sodium Salt Formulations
Engro Dalapon—Esso

DINOSEB
Formulations in Oil
Engro DNBP in oil—Esso

MALEIC HYDRAZIDE
Liquid Formulations
Vondalhyd—Bos
(This product has been approved as an onion sprout suppressant in addition to use in retarding grass growth)

MANEB
Wettable Powders
Engro Maneb—Esso

METALDEHYDE
Dry Baits
Slugoids—Doff-Portland

TCA
Sodium Salt Formulations
Stancide STCA—S.D.C. Pesticides

ACKNOWLEDGEMENT OF PHOTOGRAPHS

We gratefully acknowledge permission to use the following photographs:

Front cover and P.375 *Farmers Weekly*. P.357 Marsh and Baxter Ltd. Pp.361 and 363 National Institute of Agricultural Botany. P.366 West of Scotland Agricultural College. P.371 (top left) and P.373 F. W. Jameson. P.371 (top right) A. Rowlands. Pp. 384 and 385 Haydn Davies. P.392 *Leicester Mercury*.

AGRICULTURE

Price 1s. 3d. net monthly (by post 1s. 9d.).

Subscription Rates, Home and Overseas: £1 1s. 0d. per annum (including postage).

Subscriptions may start with any issue and should be sent to:

HER MAJESTY'S STATIONERY OFFICE

49 High Holborn, London W.C.1
13a Castle Street, Edinburgh EH2 3AR
Brazennose Street, Manchester M60 8AS
109 St. Mary Street, Cardiff CF1 1JW
50 Fairfax Street, Bristol BS1 3DE
7 Linenhall Street, Belfast BT2 8AY
258 Broad Street, Birmingham 1

Single copies can be purchased from any of the above-mentioned addresses or through a bookseller.

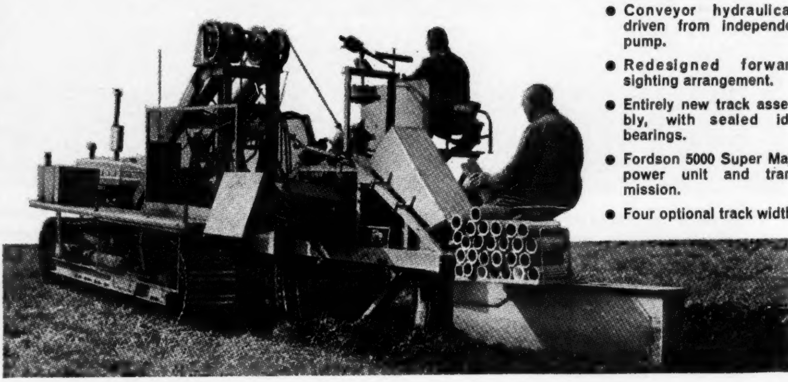
Printed in England for Her Majesty's Stationery Office by Hull Printers Limited, Willerby, Hull, Yorks.

(K89) SBN 11 720765 9

ALL THESE ADVANTAGES

MK4 LANDRANER

- Will lay 3", 4" and 6" clay tiles, or plastic pipe.
- Digging speeds up to 39 feet per minute.
- Two-speed wheel drive.
- Conveyor hydraulically driven from independent pump.
- Redesigned forward-sighting arrangement.
- Entirely new track assembly, with sealed idler bearings.
- Fordson 5000 Super Major power unit and transmission.
- Four optional track widths.



ALLEN MK4 LANDRANER

ALLEN OXFORD

JOHN ALLEN & SONS (OXFORD) LTD · COWLEY, OXFORD
TELEPHONE: OXFORD 78271 TELEX: 83172

Plasdrain

Ministry approved flexible PVC drainage tubing

pulls land drainage into the 20th Century

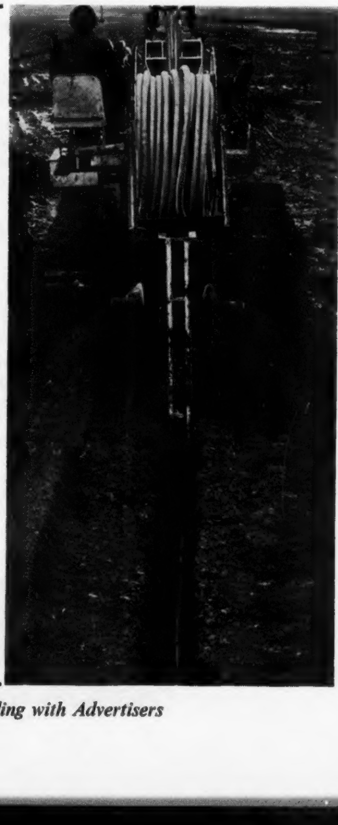
★ *Cut labour costs*
★ *Cut transport costs*
★ *Cut storage costs*
★ *Cut laying costs*
★ *Cut breakage costs*

specify

Plasdrain

by COMPOFLEX CO LTD
DELPH OLDHAM LANCS

Telephone: Saddleworth 5511



OFFICIAL APPOINTMENTS

OPPORTUNITIES IN OVERSEAS DEVELOPMENT

General agriculturists and agricultural specialists of many kinds are frequently required in the effort to match the large demand from the developing countries. The vacancies advertised below are a selection from the many openings which exist now. While they are being filled, other vacancies are arising.

Salaries within the ranges quoted are assessed on qualifications and experience; and the terms of most appointments include free or subsidised accommodation, education grants, family passages, good leave on full pay, etc. A contributory pension scheme is available in certain circumstances.

Most appointments are limited to candidates who should be citizens of, and normally resident in, the United Kingdom.

BOTSWANA

(1) Agricultural Officer (Development) — *RC 213/19/022*

Duties: To work under the Land Use Planning Unit in the planning and development of settlement schemes on state lands.

Qualifications: Degree in agriculture or natural science, preferably with planning and development experience.

(2) Agricultural Officer (Animal Husbandry Research) — *RC 213/19/019*

Duties: Research into the breeding and feeding of cattle.

Qualifications: Degree in agriculture with animal husbandry as a major subject.

Salaries: Basic (1) R.2,256—4,440 (£ Sterling 1,316—2,590), (2) R.2,256—4,800 (£ Sterling 1,316—2,800) p.a. plus an inducement allowance, normally tax free in the range £360—£660 p.a. (payable direct to an officer's home bank account). Tax free gratuity 25% of basic salary only. Contracts 2-3 years.

BRITISH SOLOMON ISLANDS PROTECTORATE

Agronomist — *RC 213/27/06*

Duties: To take charge of the Joint Coconut research scheme to design layout and analyse trials on all aspects of coconut agronomy and to carry out an approved programme of coconut breeding and conduct related experiments.

Qualifications: Degree in agriculture with experience of tropical crops, particularly coconuts, and a knowledge of statistical techniques.

Salary: A$2232—A$4272 (£Sterling 1,042—1,994) p.a. plus an inducement allowance normally tax free in the range £716—£1,160 p.a. (payable direct to the officer's home bank account). Gratuity 25%. Contract 2 years.

BRUNEI

Agricultural Officers — *RC 213/28/07*

Duties: To be in charge of a sub-district which will include one or more agricultural stations, to lay out and supervise experimental and/or demonstration plots and advise and give lectures to groups of farmers.

Qualifications: Degree in agriculture with tropical experience.

Salary: £1,992 to £3,526 p.a. Tax free gratuity 12½% of salary. No local income tax. Three years contract.

OFFICIAL APPOINTMENTS

GHANA

Adviser in Agricultural Marketing Economics *RC 213/70/017*

Duties: To advise the Chief Agricultural Economist in marketing investigations and collection of marketing information.
Qualifications: Honours degree in Agricultural Economics, Economics or Agriculture with post-graduate qualification in Agricultural Economics; and considerable experience of the marketing of agricultural produce in the tropics.
Salary: £2,475—£3,425 p.a., depending on qualifications and experience, subject to British Income Tax, plus a variable non-taxable overseas allowance from £705—£1,395 p.a. according to marital status. Contract: 18 months.

MALAWI

Agricultural Officer (Training) *RC 213/134/029*

Duties: To set up and run a training unit, to establish training courses for farmers and staff and to administer and assist a small extension aids unit in the production of teaching materials.
Qualifications: Degree in agriculture with experience in training of farmers and technical staff and in the growing of maize, groundnuts and tobacco.
Salary: £1,420—£2,600 p.a. plus a supplement of £244—£276 p.a. payable direct to the officer's bank account outside Malawi and Rhodesia. A terminal gratuity of 25% is payable on completion of tour of not less than 30 months. Contract 2–3 years.

SWAZILAND

Soil Surveyor *RC 213/169/09*

Duties: To undertake detailed Soil Surveys of irrigation projects, rural development areas, farms or estates. Also land capability studies of specific farming systems. The Soil Surveyor will work in close liaison with the Land Planning Officer and extension staff.
Qualifications: Degree in one of the natural sciences or in Agriculture and post-graduate experience in soil surveying.
Salary: Basic, R2,256—4,800 (£ Sterling 1,316—2,800) p.a. plus an inducement allowance in the range £204—516 p.a. Gratuity 25% of basic salary and inducement allowance. Contract 3 years.

ZAMBIA

(1) Plant Pathologist *RC 213/132/025*

Duties: To investigate major diseases of crops and to make recommendations for their control based on experimental results.
Qualifications: Degree in Botany or Natural Science together with some specialist training or post graduate experience in Ecology or plant pathology. A specialised degree in plant pathology would be an added advantage.

(2) Agricultural Officer (Training) *RC 213/132/022*

Duties: To direct and organise staff training and short courses for farmers at farm institutes and farm training centres.
Qualifications: A degree in agriculture with experience of advisory work.
Salaries: Basic (1) Kwacha 2,064—4,344 (£1,204—£2,534) p.a. (2) Kwacha 1,944—4,464 (£1,134—£2,604) p.a. plus an inducement allowance in the range (1) £260—£429 p.a., (2) £243—£429 p.a. Non taxable supplements, which include an element of gratuity from £233—£291 p.a. are also payable. Contracts 3 years.

If you wish to apply for any of these appointments, or you are interested generally in an appointment overseas, please write giving your full name, age and brief particulars of your professional qualifications and experience to the:

Appointments Officer
MINISTRY OF OVERSEAS DEVELOPMENT
Room 330a, Eland House, Stag Place,
London, S.W.1.

MINISTRY OF OVERSEAS DEVELOPMENT

LAMFLEX Regd Trade Mark

Plastics Land Drainage Tube

FOR AGRICULTURE PLAYING FIELDS BUILDING SITES ETC

COILED & STRAIGHT LENGTH PLASTICS DRAINAGE PIPES BY CRITCHLEY

PIPAWAY

Plastics Land Drainage Pipes

LAMFLEX- corrugated P.V.C. flexible tube in $1\frac{5}{8}''$ (46mm) $2\frac{5}{8}''$ (63mm) or 4" (100mm) dia. in coils up to 10 chains (660 ft.)

Layed by Trenching or Trenchless systems.

PIPAWAY-smooth bore P.V.C. pipes in 2" and $3\frac{1}{2}''$ dia. in 20 ft. straight lengths.

Layed by mechanical shovel or trencher.

Both systems offer **LOW COST-HIGH EFFICIENCY • MINISTRY APPROVAL FOR 50% GRANT AID**

CRITCHLEY **Critchley Bros Ltd. Brimscombe, Stroud, Gloucestershire GL5 2TH**
Tel. Brimscombe 2451 (5 lines). Telex 43194.

Weldmesh

Regd. Trade Mark

IN ROLLS, SHEETS AND CUT-TO-SIZE PANELS

Direct from:

THE B.R.C. ENGINEERING COMPANY, STAFFORD *Telephone: STAFFORD 4441*

EVENSTORM IRRIGATION—

- ★ **Rotary sprinklers** ★ **Rain guns**
- ★ **Organic irrigation (effluent disposal)**
- ★ **Portable aluminium mains**
- ★ **Glasshouse and outdoor spray lines**

EVENTHERM SPACE HEATERS—

Portable, oil-fired, up to 200,000 B.T.Us. Thermostatically controllable for frost protection in potato stores, etc.

Details from EVENPRODUCTS LTD., Evesham, Worcs. Tel. Evesham 6633/4.

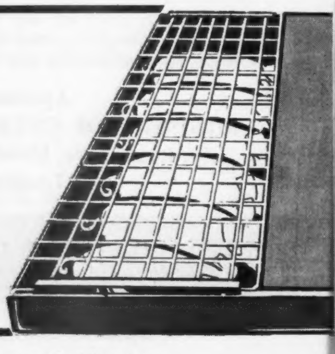
EVERY PIG FARMER NEEDS OUR NURSMAID PIGLET FEEDER

Save your litters and early wean with the

NURSMAID AUTOMATIC PIGLET FEEDER

Now your piglets need not die or suffer a slow start. Flower's Nursmaid feeds and rears with high live weight gains the modern way. More pigs reared means bigger profits which will pay for the Nursmaid many times over. Ask for our fully descriptive leaflet and quotation. Full details from

FLOWER'S EQUIPMENT COMPANY LIMITED
Boringdon Hall, Plympton, Plymouth, Devon.
Tel: Plymouth 38301



Ministry of Agriculture, Fisheries and Food

SELECTED PUBLICATIONS

Dairy Floors

Prepared by a sub-committee of the Milk and Milk Products Technical Advisory Committee, this report will be of interest to everyone concerned with the dairy industry. Architects, builders, plant designers, management and dairy technicians will find it a useful guide to all aspects of dairy floors. The main subjects covered are design; materials available; special considerations for various parts of the dairy; maintenance and repair. It contains a good bibliography. Illustrated.
8s. (8s. 6d.)

Farm Buildings Pocket-Book

Since the first edition of the Pocket-book was compiled there have been many developments affecting the accommodation of livestock and the storage of produce and materials on the farm. This revised edition gives what are accepted generally as the standards applying today.
3s. 6d. (3s. 10d.)

Commercial Glasshouses

This revised and illustrated bulletin deals comprehensively with the many developments which have taken place since the third edition was published in 1960, a time probably of more rapid change than in any similar period in the history of the glasshouse industry. Choice of site and nursery layout, glasshouse types, construction and materials, are all fully discussed, and in addition to advice on ventilation, considerable attention is given to the requirements of various types of heating systems. (Bulletin No. 115)
10s. 6d. (11s. 1d.)

Bulk Storage of Potatoes in Buildings

Discusses the siting, design and construction of buildings for the storage of potatoes in bulk. This illustrated bulletin also deals with insulation and ventilation and the questions of mechanical handling and managing the crop from the time it is put into store until it is marketed. (Bulletin No. 173)
4s. 6d. (4s. 11d.)

Prices in brackets include postage

HMSO

Government publications can be purchased from the Government Bookshops in London (post orders to P.O. Box 569, S.E.1), Edinburgh, Cardiff, Belfast, Manchester, Birmingham and Bristol, or through any bookseller

RECENT PUBLICATIONS

Lime and Liming

The purpose of this bulletin, now in its sixth edition, is to promote better understanding of the value of liming and, by providing information based on scientific knowledge and practical experience, to help the farmer in working out his liming policy. The new basis of evaluation of soil liming materials in terms of neutralizing value is explained and particulars from the new Regulations under the Fertilisers and Feeding Stuffs Acts are given.

(Bulletin No. 35) **5s. 6d.** (by post 6*s.*)

Infestation Control

Report of the Infestation Control Laboratory for 1965–67.

The fourth report of the work of the Laboratory (ICL), covering the three years ending 31st December, 1967. This illustrated account deals with the control of insect and allied pests of stored products and with research and development work on harmful vertebrate pests.

14s. 6d. (by post 15*s.* 4*d.*)

A Guide to Official Sources

Designed to provide a guide to current statistical series relating to agriculture, fisheries and food, while at the same time giving an account of the more important changes which have affected the main series since the mid-1950s. The booklet, which supersedes the first edition published in 1958, deals parimarily with economic, as opposed to technical statistics.

(Studies in Official Statistics No. 14) **12s. 6d.** (by post 13*s.* 2*d.*)

A free list of agricultural titles is available from Her Majesty's Stationery Office, P6A, Atlantic House, Holborn Viaduct, London EC1

HMSO

Government publications can be purchased from the Government Bookshops in London (post orders to PO Box 569, SE1), Edinburgh, Cardiff, Belfast, Manchester, Birmingham and Bristol, or through any bookseller